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CATHODE RAYS.

The peculiar radiations from the cathode of an exhausted vacuum tube, which were probably first noticed by Hittorf and subsequently studied at length by Varley and Crookes, had furnished little subject matter for experiment and discussion until Röntgen's brilliant discovery attracted the attention of physicists the world over to their curious phenomena. The most recent contribution to our knowledge of them is the discovery by Mr. A. A. C. Swinton, communicated recently to the Royal Society, that these rays cross at the focus of a concave cathode, and that both the convergent and divergent cones, under these circumstances, seem to be hollow and to have a remarkable circular surface tension.

The classical experiments of Crookes seemed to demonstrate beyond doubt that the cathode streams are torrents of dissociated molecules, driven normally from the surface of the cathode at a high velocity by electrical repulsion. That a convergent stream of such molecules should be hollow is not remarkable, in view of their mutual repulsions and the probable screening of the centre of the cathode surface from impacts of free uncharged molecules by the exterior layers of the converging stream.

The other phenomenon, however, of circular surface tension in the hollow cone, is an unexpected and very remarkable discovery. Whether the theory of Crookes can be reconciled with this fact remains to be seen. It is to be expected that with a change in the form of the cathode surface there should be a corresponding change in the form of the conical surface of the molecular stream, but it is strange that the splitting of the shell of flying molecules should result in a spiral movement of the greater part of them, and this in a sense contrary to what would be expected from their known mutual repulsive action.

The other fact, that the cathode streams cross at the focus without rotation is also hard to explain upon the assumption that they consist of moving electrified molecules. At the focus itself, where the condensation of these bodies would be expected to bring them well within the range of each other's repulsive forces, and possibly within danger of mutual collision, it was to have been expected that they would be violently perturbed, and that their motions would be anything else but rectilinear at this point. The whole subject of the nature of the cathode rays is likely to be reopened by the curious facts announced by this last investigator.

THE BELL TELEPHONE REPORT.

The annual report of the American Bell Telephone Company for the year ending Dec. 31, 1896, is not very different from the report for the previous year, except in the increase in the figures representing net revenues. We venture to assert, however, that the next annual report will present some features that previous reports have not embodied, and one of them will be the disappearance of the item "Commission paid Western Union Telegraph Company." The expiration of the contract between the Bell Company and the Western Union Company last November, under which the latter company has for several years received from the Bell Company a large sum of money as royalties on telephone patents controlled

by the Western Union, will necessarily cancel this item. Last year this payment amounted to $211,654, while in 1895 it was $296,-284. The financial features of the report cannot fail to be of interest and satisfactory to the stockholders, who have in the past reaped a rich harvest from their investment in telephone property.

One of the most interesting parts of the report is the reference to the telephone service in the United States. In this country the development of the telephone has attained a degree of perfection which it can safely be asserted is not equaled in any other country, and its use is extending at a rapid rate. It is pointed out that we have a number of telephone exchanges equal to the aggregate of exchanges in all continental Europe, which has a population five times greater than ours. This fact alone indicates most positively the extent to which the telephone is used in the United States, and the importance of its relations to the business interests of this country can hardly be estimated. It has become a very important factor in our affairs, and the saving of time, labor and money by its use is beyond computation. The independent telephone companies are entitled to a vast amount of credit for the favorable conditions in this field, and they are accomplishing excellent results in many parts of the country.

Practically nothing is said in the report of the Berliner case now before the United States Supreme Court, beyond the bare statement that the decision of the Court has not yet been rendered. The Bell Company has much at stake in this matter, and is very careful not to make any statements that can be misconstrued.

The relations of the Bell Company with the Western Union Telegraph Company are not mentioned at all, not even the fact that the long-standing contract between the two had expired, and there is not the slightest indication as to what course the company intends to pursue in this direction. No doubt future action along this line depends largely upon the decision of the Supreme Court in the Berliner case.

COMBINING MANUFACTURING AND ELECTRIC LIGHTING.

In an article on another page of this issue, by Mr. George T. Hanchett, the proposition is made that a high percentage of gain upon the investment could be earned in many factories if they combined with their daily manufacturing business the lighting of the town in which they are situated, or such part of it as they could conveniently reach, thus providing their machinery with a night load. In a factory equipped with an electrical-distribution system, instead of the ordinary belting and counter-shafting, it would seem that this idea could be applied with success.

The converse proposition, that an electric-lighting installation could make an arrangement to furnish a manufacturer in its vicinity with power during the day, has been carried into effect for the last ten or fifteen years in many places. It has been a desideratum, ever since electric-lighting installations on a large scale were first attempted, to provide the station with a load of motors during those parts of the twenty-four hours when the lighting load sinks to relative insignificance. The difficulty about this and all other similar plans is that the seasons and the hours of daylight and darkness are not regulated by the desires of the manufacturer or the electric-light station superintendent.

Allowing, for the moment, that a perfectly satisfactory system of distribution of light and power could be devised upon the basis suggested by Mr. Hanchett, it is certain that there would be many hours when the two loads would overlap. In this country, where frequently in the winter time factories, closing at about 6 o'clock in the evening require at least three hours of lighting, it would necessitate the installation of so large a plant that the apparent economy would probably disappear. The load borne by the generating station under these circumstances would present much the same characteristics as the ordinary lighting load when no power supply is attempted. There would be a sharp rise in the demand at the hours when the lights were first needed, followed shortly afterward by a large drop when the manufacturing establishments closed for the night.

The ingenious system suggested by Mr. Hanchett, whereby two alternating generators can be run during the day as a single triphase unit, and run separately or in parallel as a source of single-phase currents for lighting, would require an ordering of the times of day and darkness which does not obtain, in this part of the world at any rate. While the suggestions contained in this article are of interest and may be fruitful, it is hardly likely that they contain the solution of the much-discussed problem of a profitable day load for electric-lighting installations. It would seem better for the electric light company to go into the manufacturing business itself, so that it might be able to regulate the hours for the use of its output in this way by the demands for light on its consumer's circuits.

THE TROLLEY IN ENGLAND.

The intense conservatism of the English has been well shown by their opposition to the overhead trolley system in the streets of their cities. It is encouraging to note that a deputation, recently sent from Sheffield to certain continental cities to study the operation of trolley systems there, upon its return recommended and secured the adoption of this method of traction.

Another commission, however, returning to Birmingham from a similar voyage of exploration, is insisting upon the use of a conduit system in that city. If its recommendation is carried out about every system of street railway traction known will be represented there, as Birmingham has now in existence lines operated by horses, cable, steam, and the accumulator system.

In the crowded manufacturing cities of England the cheaply installed and flexible overhead system would prove an inestimable benefit. In the short space of ten years, since its inauguration in this country, the development of suburban districts and the relief of congested areas through its means have been marvelous. From a purely humanitarian point of view, anything that could better the domestic circumstances and surroundings of the average English mechanic should be hailed with acclamation. A cheap and rapid system of transit would doubtless result there, as it has in so many cases here, in encouraging this class of the population to leave the crowded tenement districts and find more healthful and pleasant homes further from their workshops.

Telephony Between France and England.

Arrangements have just been completed for laying two additional telephone cables across the English Channel. Each cable will contain two circuits, so that with the one now in use there will be six circuits available, instead of two as at present. When the additional cables are installed, facilities for international telephony will be extended to the large commercial centres in both France and England, instead of confining them to London and Paris as at present.

The Approaching Retirement of Mr. Preece.

According to the London papers Mr. Wm. H. Preece recently stated that it was his intention to retire, in eighteen months, from the General Post Office of Great Britain, in which he has been the chief of the telegraph department. He has been engaged with electrical matters for the past forty-five years.

Profitable Day Load in Alternate Current Systems.

BY GEORGE T. HANCHETT.

A profitable day load for an electric light station is highly desirable. There are, however, thousands of factories consuming large amounts of power, which are shut down all night, and while much capital lies idle in them, no complaint is made by stockholders in these manufacturing industries. A profitable night load has not been regarded as a crying necessity, but it has occurred to the writer that there must be many cases in which a combination of the lighting of a town, and the manufacture of woolen, paper and cotton goods could be profitably made.

The use of electric power in factories to avoid long lines of shafting and numerous belts, and the expense of maintenance and loss of power contingent upon them, has been generally accepted as a move in the right direction. Relative first cost of an electrically driven factory and one driven by shafting is, of course, slightly in favor of the latter, but the diminished cost of operation of the former has impelled many industries to make the change.

Now if in addition to the driving of the factory during the day the output of the generators could be turned into a system of street and house lighting at night, there would be a source of revenue equal to that of an electric light station of the same capacity and unencumbered with many expenses that an electric light station alone would involve.

The items of interest and depreciation on the plant would be divided by two. There would then be only interest and depreciation on the line, and on the transformer system if there was one.

The income from the station, less the expenses of night operation, would pay a percentage on the capital stock almost double that of an ordinary electric lighting station operating under the same load.

There are certainly many manufacturing towns where an electric lighting station would not pay, but where an arrangement of this kind would prove very profitable.

Where the establishment of an industry is contemplated it would certainly be a wise move to increase the capital stock a very small amount, use electrical transmission in the factory, and then obtain a franchise to supply the town with electric lights. Conversely, an electric lighting installation could make an arrangement with a local manufacturer, whereby he could obtain the advantages of the electric transmission in his factory, and the electric lighting station could obtain a day load. It is evident from a business point of view that it would be much better if the lighting and manufacturing interests were combined under one management, since there would then be harmonious operation.

In large cities where the power necessary to operate a factory would by no means be sufficient for the lighting of the place, a system of block lighting might be resorted to, each block being taken care of by one of the numerous manufacturing interests which a large city frequently contains. This block lighting competition has been pointed out by other writers to be a most formidable foe to the central station, but coupled with the manufacturing interest as set forth in this article it would be well-nigh invincible.

A word or two about the best machines to use in such service will be appropriate. A combined motor and lighting load suggests to the electric lighting man a direct current system, but it is very doubtful whether this would be advisable. In small towns where the number of subscribers would not be many, an expensive line, which in this kind of a station is really the major cost of the system, would not be justifiable. In large cities the block or district which was lighted by the factory plant might be at some distance from the factory, so that an alternating line would be imperative, and therefore as far as the lighting is concerned an alternate current system would generally be preferable. It will immediately be argued that there is no alternate current system which is perfectly satisfactory for both lighting and power, and the time-worn objection of inferior regulation would probably be offered.

The writer has no patience with the latter objection. The boasted precise regulation of direct-current systems, as obtained in large cities, is secured at the expense of vigilant hand regulation, and there is no earthly reason why alternate current systems will not regulate equally well. If the compound alternator was tabooed in the central station as the compound direct-current machine has been, the results would be just as satisfactory.

Through the ingenuity of Mr. John F. Kelly an alternating current booster has been devised which has neither commutator nor brushes, and is in every way simpler than the direct current booster, which comprises two machines and two commutators. With the alternating booster any feeder may be combined in precisely the same way as in direct current stations.

The device of providing bus bars of different voltages and a switch throwing a feeder on to any one of these bus bars at pleasure, can be accomplished in the alternating current system with a single machine and in fact every aid to exact regulation that the direct current system has can be obtained in the alternating, with perhaps the exception of the storage battery.

The flexibility of distribution on alternate current systems has numerous advantages which need not be mentioned here.

The first objection is, however, more serious. It is certainly true that neither two nor three phase systems are satisfactory for both power and lighting. The unbalancing of the circuits is, of course, a popular objection, and usually the one that first comes to mind, but there is a more serious annoyance. It very often happens that a heavily-loaded circuit requires more than one-half the output of the machine, and that another circuit is so lightly loaded that the other half of the machine has power to spare. The engineer may therefore see his machine with one side overloaded and be unable to relieve it with the ample power of the other side because it is in a different phase. The writer has suggested in other articles the device of coupling two alternators together at 90° or 120° apart to produce two or three phase currents and thus enable a power load to be carried, but this device is peculiarly adapted to the combined manufacturing and lighting interests referred to in the first part of this article. By a suitable coupling it can be arranged to be the work of but a few moments to change the alternators from 90° of phase to exact synchronism, thus changing the two phase station into a single phase station. These alternators can be directly coupled to either side of a moderate-speed engine, provided the plant is large enough to admit of such large machines as these will necessarily be, or two alternators can be set upon the same base and have a common driving pulley. During the day the station can be a two or three phase station and drive the factory by means of induction motors, which, in their entire absence of commutators, brushes, and collecting devices, are ideal for the use, or rather abuse, of ignorant factory hands, since they can never get out of order. After the factory is shut down, a few moments' work changes the station into a single-phase station to meet the lighting load which will probably begin to come on. It is obvious that two such generators are bound to operate to complete satisfaction in multiple; they can never get out of step. When operating as two-phase generators the phases may be regulated by the varying of the field currents one absolutely independent of the other, and a formidable objection to the two-phase generators as ordinarily constructed is thus overcome.

It will be well to have two generating sets, both of them adjustable to either single or multiple phase out-puts, one of them large enough to carry the factory day load and the lamp night load, and the other of suitable size, and evidently much smaller, to carry the lamp day load and the motor night load. The little machine would save interruption of service, which is most important, and would also carry such motor load as might be on after the factory was shut down. During the day it would probably be better to shut it down for the larger generator could undoubtedly carry the day load on one or both of its phases. With such an installation every conceivable convenience which electricity affords could be used in the factory and a profitable and satisfactory light service could be established.

With regard to the use of direct-current apparatus in such an installation it is necessary to say but little; it is so thoroughly familiar to every electric lighting man that there is no doubt that if used it would be arranged to best advantage. It is well to mention, however, that in comparison with the alternating system it is peculiarly at a disadvantage in such an installation as this. In the first place, there is no doubt of the almost infinite superiority of the induction motor over the direct-current motor; and in the second place, one of the principal economies of the alternating system is first cost in the line. This as previously stated would form about 50 per cent. of the capital stock of the lighting interests of such a combination, and would be entirely too large a factor to be overlooked.

Alternating-Current Machinery.—VIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Chapter VIII.

74. When an electric current passes through a conductor, the conductor becomes surrounded by a magnetic field. Fig. 47 represents, by curved arrows, the distribution of magnetic flux in a plane at right angles to an indefinitely long, straight conductor, *C* in which a current is passing through the wire at the centre, in a direction through the paper away from the observer. If the direction of the current be reversed, so as to pass through the paper in a direction toward the observer, all the magnetic flux will be reversed in direction, so that all the curved arrows will

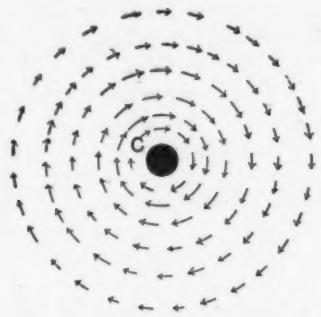


Fig. 47.—Magnetic Flux Surrounding Linear Conductor Carrying Electric Current.

point in the opposite direction. The magnetic flux is densest at the surface of the wire, and diminishes in density inversely as the distance to which we recede from the wire. The density of the magnetic flux in air, or other non-magnetic material, surrounding the wire, is expressed by $\mathfrak{B} \frac{2 I}{l}$ gausses, the *gauss* being the C. G. S. unit of magnetic density, or one C. G. S. unit of magnetic flux per square centimetre. I is the strength of current in the wire in amperes, and l is the distance from the axis of the wire in centimetres. Within the wire the magnetic flux diminishes in density to the centre or axis, where it vanishes.

75. When two wires, *C* and *C'*, Fig. 48, form the going and returning conductors of a circuit or loop, so that the same current strength passes, say through the paper toward the observer in *C'*,

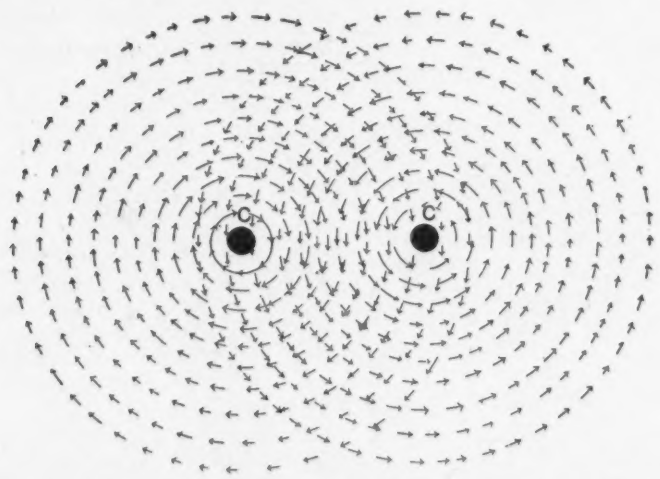


Fig. 48.—Magnetic Flux Surrounding a Loop Circuit or Pair of Parallel Conductors, Forming Portion of an Active Loop.

and through the paper away from the observer in *C*, each conductor may be considered to be surrounded by its own magnetic flux, as though the other conductor were not present. Under these conditions it will be seen that in the centre of the loop there will be two streams of magnetic flux distribution, directed through the loop in the same direction; namely, downward, while outside the loop the magnetic flux from one wire is oppositely directed to that from the other. Consequently, the resultant magnetic flux is stronger inside the loop than it would be if only one wire were present, while outside the loop it is weaker. By geometrically summing the two independent magnetic densities at each point, by the method of plane vectors, the actual resultant distribution of magnetic flux is arrived at and is represented diagrammatically in Fig. 49. If the direction of the current in the conductors around the loop be reversed, the direction of the entire

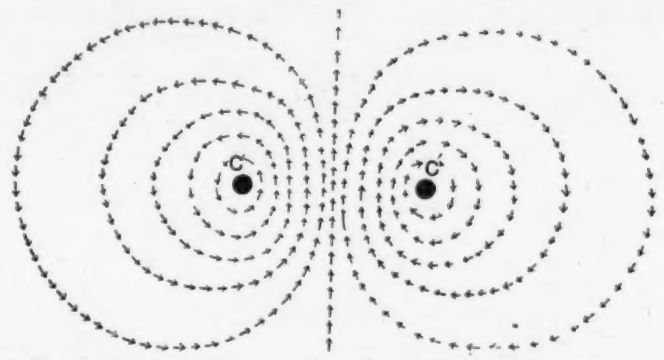


Fig. 49.—Resultant Magnetic Flux Surrounding Pair of Parallel Conductors, Forming Loop Circuit.

flux distribution will be reversed as shown in Fig. 49, but, as before, the flux density at any point will remain unchanged.

76. When, therefore, an electric current is passed through a circuit, since every circuit necessarily forms a closed loop, the magnetic flux threads through the loop in one direction or the other according to the direction of the current. Thus, in Fig. 50, if *E* represents a generator or source of steady current, and a b a' b', a loop, or circuit supplied by the same, then the presence of the electric current around the circuit is attended by the establishment of a magnetic flux through the loop, as indicated by the curved arrows. The longer and broader the loop, the greater will be the amount of magnetic flux which a given current will send through

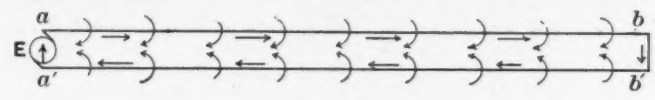


Fig. 50.—Diagram of Loop Showing Directions of Electric Current and Magnetic Flux.

it. If we double the length of the loop with the same current strength, and distance between the conductors, *i. e.*, the same breadth of loop, we double the total quantity of magnetic flux linked or associated with the conductors. If we double the current strength in the same loop, we double the magnetic flux linked with the conductors, and if we separate the conductors to a greater distance, or increase the area of the loop, we increase the magnetic flux threading through or linked with it, although not in the same proportion as the breadth. That is to say, if we double the breadth of the loop, keeping the length the same, the magnetic flux linked with it is not doubled. It is here assumed that no iron is associated with the circuit, but that the circuit is situated in non-magnetic material, such as air, wood, etc.

77. The total quantity of magnetic flux linked with a circuit, or portion of the same, per unit of current strength passing around it is called the *inductance* of that circuit or portion. Thus, the number of webers of magnetic flux linked with a circuit carrying one C. G. S. unit of current (10 amperes) is the inductance of that circuit, and is expressed in *centimeters*. If a loop or circuit

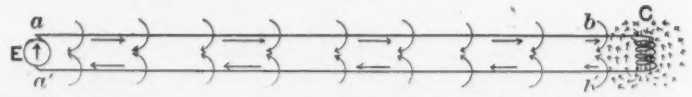


Fig. 51.—Diagram of Loop Circuit with Coil, Showing Directions of Electric Current and Magnetic Flux.

carrying 10 amperes, or one C. G. S. unit of current, has a total magnetic flux of say 1,000,000,000 webers, or C. G. S. units of magnetic flux passing through it, the inductance of the circuit will be 1,000,000,000 centimeters, or 10,000 kilometers, a length which by definition is equal to a quadrant of the earth's surface measured from pole to equator. This is based on the existing system of electric and magnetic units, in which the quotient obtained by dividing the C. G. S. unit of magnetic flux by the C. G. S. unit of current is the C. G. S. unit of length, or one centimeter. The fact that the C. G. S. unit of inductance is a

length of one centimeter may be accepted as an arbitrary convention.

78. For practical purposes, in connection with the system of volt, ampere and ohm units, the practical unit of inductance is not taken as the centimeter, or C. G. S. unit, but as 10^9 centimeters, or the earth quadrant, and is called the *henry*, so that one henry is an inductance of 1,000,000,000 C. G. S. units of inductance. Consequently, if a circuit has linked with it a total magnetic flux, of say, 3,000,000,000 C. G. S. units or webers, and carries a current of 15 amperes, or 1.5 C. G. S. units, the inductance of the circuit will be $\frac{300,000,000}{1.5} = 200,000,000$ centimeters, or 2 henrys. The same result will be obtained if we take the henry as the number of webers linked with a circuit carrying one ampere, divided by 100,000,000. Thus, if a circuit carrying 5 amperes has a total magnetic flux linked with it of 50,000,000 webers, or 10,000,000 webers per ampere, its inductance in henrys will be this quantity divided by $100,000,000 = 0.1$ henry, or 100 millihenrys, the millihenry being the thousandth part of a henry.

79. When a circuit, instead of consisting of a single loop, contains a number of loops, the total flux, linked with the circuit, is considerably increased, since each loop adds to the flux linkage. Thus in Fig. 51, the loop circuit of Fig. 50 terminates in a coil, *C*,

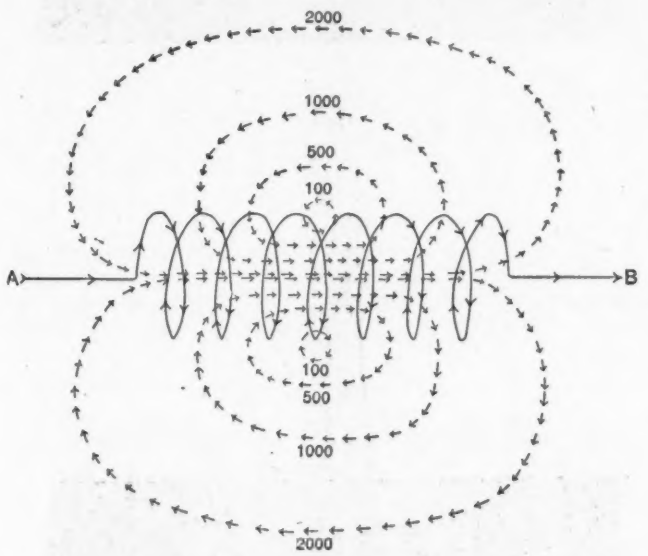


FIG. 52.—DIAGRAM OF COIL OF SEVEN TURNS LINKED WITH MAGNETIC FLUX.

of five turns, and is supplied with a continuous E. M. F. at E. If we suppose that 2 amperes flows steadily through the circuit, the flux linked with the parallel conductors may be, say, 40 megawebers (40,000,000 C. G. S. units of flux), and the flux linked with each turn of the coil, say, 10 megawebers. As there are five turns in the coil, through each of which these 10 megawebers pass, the total flux linked with the coil will be 50 megawebers. The flux per ampere in the circuit will therefore be:

Linked with conductors	$\frac{40,000,000}{2}$	= 20,000,000	webers per	ampere	= 0.2 henry.
" " coil	$\frac{50,000,000}{2}$	= 25,000,000	"	"	= 0.25 "
" " whole circuit	$\frac{90,000,000}{2}$	= 45,000,000	"	"	= 0.45 "

80. In the case of the coil represented in Fig. 51, we have assumed that the same magnetic flux, namely, 10,000,000 webers, or 10 megawebers, passed through each of the five turns. This, however, will not usually be true, and in some cases it will be far from being true. Suppose that a coil of seven turns, such as shown in Fig. 52, carries 1 ampere, and that through all seven turns together there pass 4,000 webers, through the central five turns together there pass 2,000 webers; through the central three turns 1,000 webers; and through the central turn, 200 webers. Then the total flux linked with this current in the coil will be:

$$\begin{aligned} 7 \times 4,000 &= 28,000 \\ 5 \times 2,000 &= 10\,000 \\ 3 \times 1,000 &= 3,000 \\ 1 \times 200 &= 200 \\ &\overline{41,200} \end{aligned}$$

and since this flux is linked with one ampere, the inductance will be $\frac{41,200}{100,000,000} = 0.000412$ henry $= 0.412$ millihenrys.

Or, the same result may be reached as follows:

Through the first	turn there passes		4,000 webers.
" " second	" "	2,000 + 4,000 =	6,000 "
" " third	" "	1,000 + 2,000 + 4,000 =	7,000 "
" " fourth	" "	200 + 1,000 + 2,000 + 4,000 =	7,200 "
" " fifth	" "	1,000 + 2,000 + 4,000 =	7,000 "
" " sixth	" "	2,000 + 4,000 =	6,000 "
" " seventh	" "	4,000 =	4,000 "
Total flux linked with the current			= 41,200 "

81. In Fig. 53 a single loop of wire is represented at *A*. When a current of one ampere passes around this loop we may suppose that the total quantity of flux passing through it, in the direction represented by the arrow, is 2,000 webers, so that the

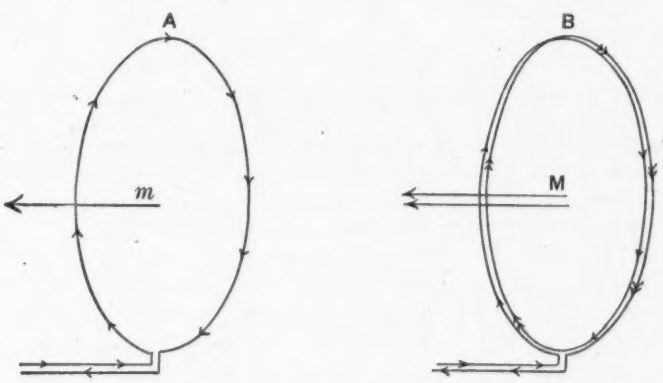


FIG. 53.—DIAGRAMS OF SINGLE AND DOUBLE LOOPS CARRYING STEADY CURRENT AND LINKED WITH MAGNETIC FLUX.

inductance of the loop will be 0.00002 henry, or 20 *micro-henrys; i. e.*, twenty millionths of a henry. If the current strength were increased to 2 amperes, the flux linked with the loop would increase to 4,000 webers, leaving the inductance or ratio of flux to current unchanged. At *B* two turns or loops of wire are placed very close together, so that one ampere passes first round one loop and then round the other. Under these conditions the effect will be practically the same as though a single turn of wire existed carrying 2 amperes. That is to say, the flux indicated by *M* would be double that which passes through loop *A*. Moreover this double flux is now linked with both of the turns in *B*, so that the total flux linkage with the two loops, when 1 ampere passes round them, is $4,000 \times 2 = 8,000$ webers, making the inductance 80 microhenrys. In other words, doubling the number

TABLE OF INDUCTANCES PER MILE OF 5,280 FEET OF COPPER WIRE WHEN SUSPENDED IN PARALLEL PAIRS—MILLIHENRYS.

Interaxial Distance. Inches.	0000 0.460"	000 0.4096"	00 0.3648"	0 0.3249"	1 0.2893"	2 0.2576"	3 0.2294"	4 0.2043"	5 0.1819"	6 0.1620"	7 0.1443"	8 0.1285"	9 0.1144"	10 0.1019"	11 0.09074"	12 0.08081"
3	0.907	0.944	0.982	1.019	1.056	1.094	1.131	1.168	1.206	1.243	1.280	1.317	1.355	1.392	1.429	1.467
6	1.130	1.168	1.205	1.242	1.280	1.317	1.354	1.392	1.429	1.466	1.503	1.540	1.578	1.615	1.652	1.690
9	1.260	1.298	1.335	1.372	1.410	1.447	1.485	1.522	1.559	1.596	1.634	1.671	1 709	1.746	1.783	1.820
12	1.353	1.391	1.408	1.465	1.502	1.54	1.577	1.614	1.652	1 689	1.727	1.764	1.801	1.838	1.875	1.913
18	1.484	1.521	1.558	1.596	1.633	1.671	1.708	1.744	1,781	1.820	1.857	1.894	1.931	1.968	2.007	2.044
24	1 576	1.614	1 651	1.688	1 725	1.764	1.800	1.838	1.875	1.912	1.949	1.986	2.025	2.061	2 099	2 135
30	1.648	1.686	1.723	1.760	1.797	1.835	1.871	1 910	1.947	1.984	2.021	2.058	2.097	2 134	2.171	2.208
36	1 707	1.745	1.784	1.818	1.856	1.893	1.931	1.968	2.005	2.043	2.079	2.117	2.155	2.192	2.229	2.266
48	1.799	1.836	1.874	1.911	1.949	1.986	2 023	2.061	2.099	2.135	2.172	2.209	2.248	2.285	2.322	2.359
60	1.871	1.909	1.946	1.982	2.023	2.058	2.095	2.132	2.169	2.208	2.245	2.282	2.319	2.356	2.393	2.432
72	1.930	1.968	2.005	2.042	2.079	2.116	2.154	2.192	2.229	2,266	2.303	2.340	2.376	2.415	2.452	2.489
84	1.971	2 016	2.053	2.092	2.128	2.166	2.203	2.240	2.277	2.312	2.351	2.389	2.427	2.464	2,502	2.539
96	2.023	2.059	2.097	2.134	2.172	2.210	2.246	2.283	2.321	2.356	2.395	2.433	2.470	2.507	2.546	2.582

of turns has increased the inductance of the coil fourfold, because there is twice as much flux, and it is linked with twice as many turns. In the same way, if the coil is made up of three loops, very close together, there would be three times as much flux from 1 ampere circulating around them as there would be from a single turn, and this trebled flux being linked with three turns, the inductance of the combination would be nine times as great as with a single loop of the same area. Generally, therefore, the inductance of a coil increases as the square of the number of turns it contains. This rule, however, is only true to the first approximation, because when the turns occupy a considerable space and are separated by a considerable distance from each other, it happens, as roughly indicated in Fig. 52, that much of the flux which proceeds from one turn fails to pass through its neighbors, and consequently fails to increase the inductance according to the law of squares. Even, however, when allowance is made for the deviation from the law of squares, owing to *magnetic leakage*, the inductance of coils of many turns is very considerable. Thus the inductance of a Thompson mirror galvanometer having many turns of fine wire in its coils may be several henrys.

82. The table (page 527) gives the inductance of parallel conducting wires of copper expressed in millihenrys per mile of wire. Thus if two overhead copper wires No. 4 B. & S. gauge are suspended at an interaxial distance of 2 feet, the inductance per mile of each wire will be 1.838 millihenrys, and the inductance of a loop 1 mile in length formed by a pair of such wires would be double this, or 3.676 millihenrys. In other words, a loop of these wires 1 mile long would hold $\frac{3.676}{1000} \times 100{,}000{,}000 = 367{,}600$ webers for every ampere of current passing around the loop. For ordinary purposes it is useful to remember that the inductance of such pairs of aerial copper wires is about 2 millihenrys per mile per wire, or about 4 millihenrys per mile of loop.

Some Experiments with Cathode Rays.

At a recent meeting of the Royal Society a paper by Mr. A. A. C. Swinton was communicated by Lord Kelvin, the subject being "Some Experiments with Cathode Rays."

The paper opened with remarks upon the desirability of a more thorough investigation of the discharge in Crookes tubes, which are so extensively employed for the generation of Röntgen rays. It was found that by replacing the usual fluorescent screen with a disc of ordinary electric light carbon, phenomena previously invisible made their appearance. When a concentrated stream of cathode rays impinges upon the carbon an intensely bright and distinct luminous spot is formed. This bright spot is apparently a surface phenomenon, since it follows the focus of the stream of rays, with no perceptible lag, when the cathode discharge is deflected by a magnet. While the whole carbon gradually becomes heated these luminous spots are instantly produced, even with comparatively low-powered rays. The phenomena of fluorescent fatigue, well known in the case of glass, are also exhibited by the carbon. In the experiments described below it was found necessary to keep the tubes connected to a mercury pump, on account of the volatile matters occluded in the carbon, which tended to continually reduce the vacuum.

In tubes of the ordinary focus type with a single concave spherical cathode, the rays coming off normally from the cathode surface seem to converge in a cone to a focus, and then, if the vacuum be not too high, to diverge again immediately. The focus seems to be always more distant from the cathode than its centre of curvature, but this variation seems to grow less with increasing vacua. This effect may be explained by the mutual repulsion of the cathode rays or streams and accords well with the assumption that they consist of charged particles.

With a carbon disc instead of the usual platinum screen for the reception of the rays, it is noted that the cone seems to be hollow, the luminescent portion of the carbon taking the form of a brilliant and apparently white-hot ring, with a dark and seemingly cold interior. As the dimensions of the cone of rays is varied by altering the vacuum, this ring varies in size accordingly, becoming brighter as it grows smaller. Fig. 1 shows these hollow effects in the divergent cone as produced by spherical aluminum cathodes, the exhaustion proceeding from rather low vacuum at the left of the illustration to very high at the right. The diameter of the luminous ring may be altered by moving the anti-cathode away from or toward the focus of the stream of rays. If the carbon surface is not at right angles to the line of discharge, the ring takes the usual conic section form. A magnet brought near the tube distorts the ring from a circular shape and moves its position on the carbon. From these experiments it appears that the divergent

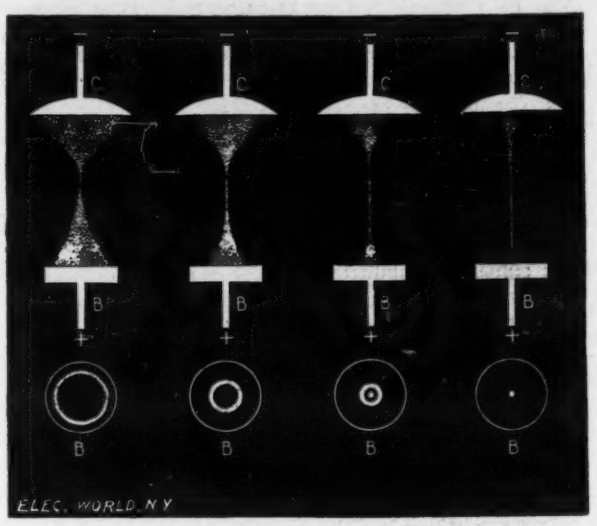


Fig. 1.

cone of cathode rays acts as though it were not of uniform density throughout its section, and in some instances as if it were completely hollow. Experiment on the convergent cone of rays is considerably more difficult by reason of the disturbance produced by the anti-cathode when brought within the focus of the cathode, especially with high vacuum. It was determined, however, that the convergent cone also acts under certain circumstances as though it were hollow, and generally acts as if it had considerable tendency toward hollowness at low vacuum. Fig. 2 shows the appearances of the ring upon the carbon anti-cathode at two different degrees of exhaustion, B representing higher vacua than B′. The tube used in these experiments contained a small carrier, connected by means of two aluminum wires to the anode terminal, and

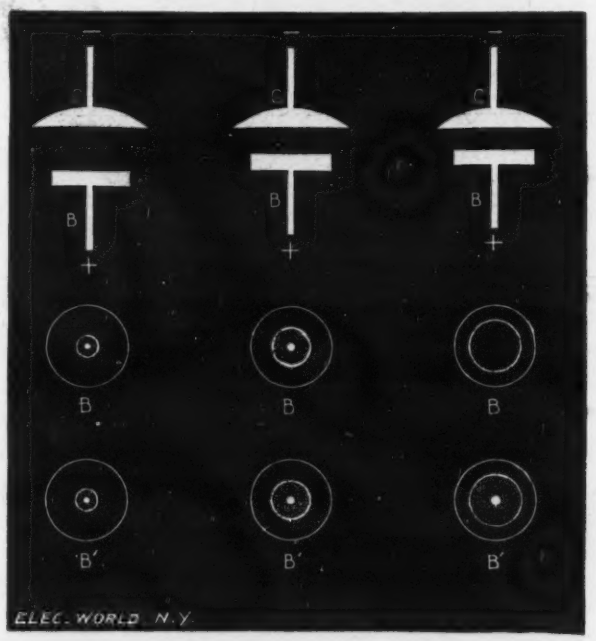


Fig. 2.

carrying a small button of electric light carbon, which presented a plane surface to the cathode. This could be moved toward or away from the cathode by inclining and gently tapping the tube.

In order to investigate the cathode rays still further and especially to discover whether the various rays from the cathode cross one another at the focus, or diverge again without crossing, and in order to discover whether there is any twist or rotation of the rays, a tube was constructed similar to the one previously used with the carbon anti-cathode fixed at the opposite side of the

focus, and with the focus about equally distant between it and the cathode. The peculiarity of the tube consisted in the fact that a sector of the aluminum cathode equal to one-eighth of its total area, had been entirely cut away. It was expected that on using this tube, with a proper degree of vacuum, a well-defined ring would be formed on the carbon, and that a portion of this ring corresponding to the amount of cathode cut away would be found wanting. By the position of this gap it would be easy to determine whether the rays crossed at the focus and whether there was any rotation. A most unexpected phenomenon was observed, the gap in the ring appearing, but instead of being one-eighth the circumference it was seven-eighths, the amount of the ring visible corresponding exactly to the arc of the removed sector of the cathode. As the portion of the ring visible was in each case exactly in line with the part of the cathode that had been cut away, it would appear that there is no rotation of the cathode beam as a whole, that the rays do cross at the focus, and further, that when the whole convergent cone is split in this manner, some unexplained action similar to circular surface tension causes the gap to widen out, and the remaining portion of the ring-shaped section of the cone to contract correspondingly; without, however, altering its diameter.

Another tube was constructed, having a complete cathode, and containing a small aluminum obstacle, which could be placed in either the divergent or convergent cone. This was arranged to fill up nearly one-quarter of the circular sectional area of the tube, though not reaching quite to its centre. The appearance seen are illustrated in Fig. 3, where the obstacle is shown near the focus and at two positions in the divergent cone of rays. In each of the last two positions exactly one-quarter of the ring on the anti-cathode failed to appear. There was again no displacement of the gap in the ring, and there was no rotation in the divergent cathode cone. With the obstacle in the convergent cone the appearances shown in Fig. 4 were noted. With the point just entering the convergent cone, a small portion of the ring was cut out, but on the opposite side, confirming the previous experiments, which showed that the rays crossed one another's paths at the focus without rotation. Upon moving the object a little nearer to the cathode, so that its

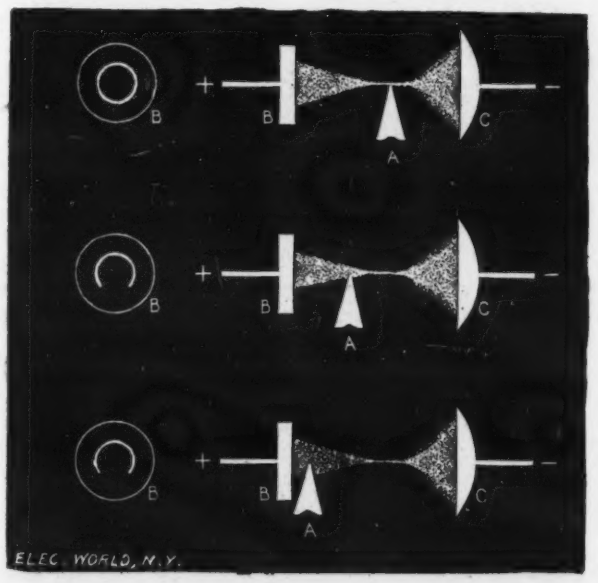


Fig. 3.

point entered a little further into the convergent ring, one-half of the ring disappeared. When the obstacle, which was only one-quarter of the circular area of the tube, was brought close up to the cathode, only about one-quarter of the ring remained. When cathode rays are focused by means of a magnet, it was shown that with both convergent and divergent cones of rays the whole of the appearances noted in the former experiments were present.

Experiments were conducted at a very high vacua with a concave cathode constructed of carbon. Under conditions of vacuum too high to show any divergent cone, the convergent cone of rays appears to contract in diameter at its base and come off from the central portion of the cathode only, the remaining surface being apparently inactive. The surface of the carbon cathode became luminescent exactly in the same manner, but in a somewhat less degree than the surface upon which the rays were concentrated in the previous experiments. Whether this luminescence of the carbon cathode at the point where the rays leave it is due to violent tearing away of the carbon particles or other causes is difficult to say, but the fact that at high vacua the cathode streams come off entirely, or almost entirely at any rate, from a very small portion of the centre of the cathode, explains the fact that large

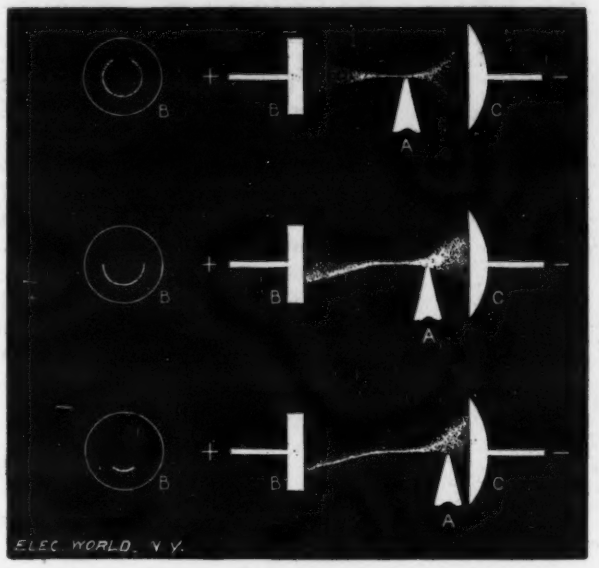


Fig. 4.

cathodes have no advantage over small ones in Röntgen-ray tubes. During the above experiments, very bright sparks were occasionally observed coming off the cathode and passing through the focus. It was thought that possibly by placing two concave carbon cathodes facing one another, such particles, by being caused to rebound backwards and forwards continuously between the two, might render the form of the cathode stream visible in very high vacua, when the stream itself becomes otherwise invisible. A tube was constructed in this manner and gave at high exhaustions very beautiful effects, showing clearly the form of the cathode discharge in vacua where it is usually quite invisible. At very high exhaustion a straight thin stream of bright golden-colored particles of apparently incandescent carbon passed between small bright spots at the centres of each cathode. In a few seconds, as the vacuum failed, two cones were established, and the collisions of the separate particles at the focus were clearly observed. After several repetitions of this experiment the glass of the tube became perceptibly blackened, which goes to show that the particles consist of carbon torn off the surface of the cathode. Further experiments tended to show that it was necessary for the cathode stream to impinge upon solid matter for the production of Röntgen rays, as none were produced at the double focus of the last mentioned tube where the streams themselves collided.

Electrical Work in Japan.

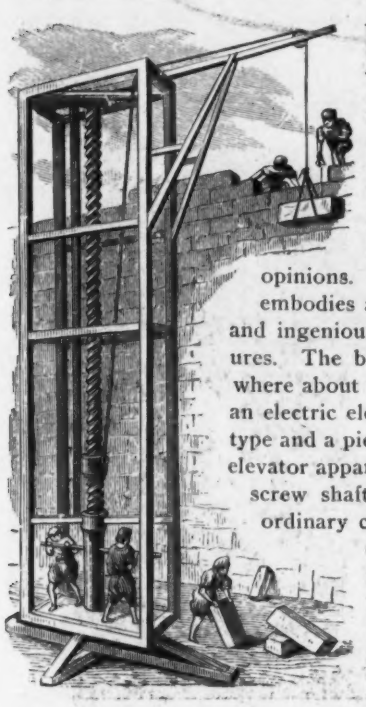
The rapid progress along all scientific lines in Japan, combined with frequent earthquakes in that country, which have proved very destructive to gas pipes, has resulted in numerous electrical installations for lighting. Hardly any large town in the more accessible parts of the country is without a station, and there is an increasing demand for dynamos, motors and other apparatus. The Japanese have already begun the manufacture of dynamos. The Mitsui-Bussan Company in Tokyo has already turned out some very creditable types of two-phase alternators. The most complete plant in Japan, and one that would be creditable to any city, is that of the Kioto City Electric Works in the town of that name.

Admitted a Telephone Conversation as Evidence.

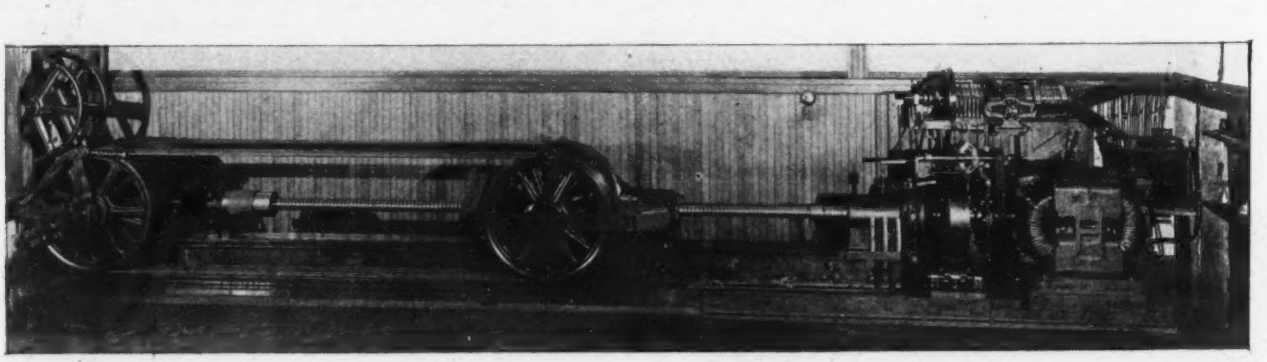
Judge Bundy, in Anderson, Ind., on April 13, made a ruling which is said to be the first of its kind rendered in the United States. During the hearing of an accounting case, the defendants sought to introduce as evidence a conversation held over the telephone between the parties to the litigation. Objection was raised, but the Court ruled in favor of the defendants, and admitted the legality of the telephone and the telephone conversation as evidence.

Electric Elevators.—IV.

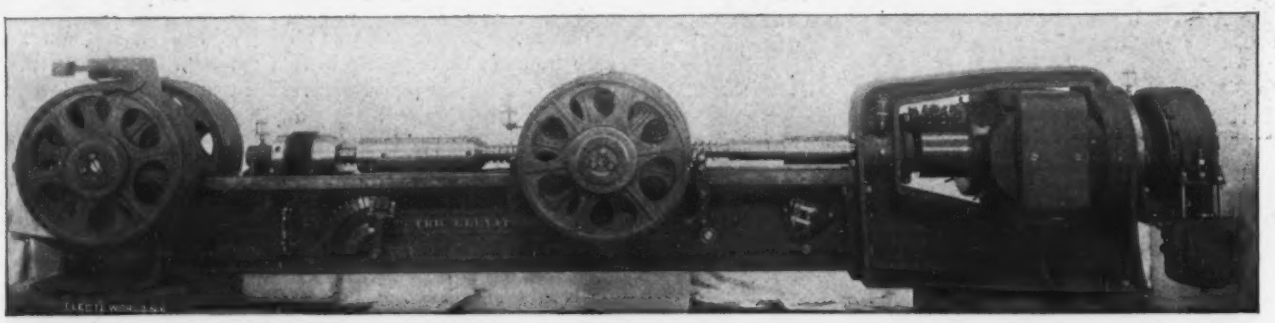
THE SPRAGUE PRATT MULTIPLE SHEAVE ELECTRIC SCREW ELEVATOR.



PROMINENT and unique among electric hoisting mechanism is the screw and sliding nut elevator built by the Sprague Electric Elevator Company. Starting from a small beginning it has been wonderfully developed, successfully silencing a multitude of adverse opinions. In its present construction it embodies a number of peculiarly excellent and ingenious mechanical and electrical features. The birth of this machine was somewhere about 1889, when Mr. C. R. Pratt built an electric elevator, which was the first of its type and a pioneer of direct-connected electric elevator apparatus, as well, consisting of a long screw shaft which engaged with a nut of ordinary construction, carrying a movable crosshead and sheaves. The screw shaft was rotated by a 25-horse-power motor, which was spur geared at 10 to 1 to the shaft. Regulation was effected by means of an ordinary series rheostatic street car controller operated by a hand rope. The satisfactory operation of direct-connected motors under these conditions was at this time a much-mooted question, and a clutch was therefore provided in the motor shaft to permit the motor to start without load. The possibilities of this type of electric elevator machine led Mr. Frank J. Sprague to take up its development, which has resulted in the present perfected multiple sheave screw machine. This machine has seen an amazing evolution from its beginning to its present perfected condition. Electric pilot motor control, ball-bearing and safety nut, ball-bearing thrusts, and many other features have given this machine a particularly prominent position. The main idea followed, however, has been to meet the hydraulic machine in the general principles of car operation.



EARLY ELECTRIC SCREW ELEVATOR MACHINE.



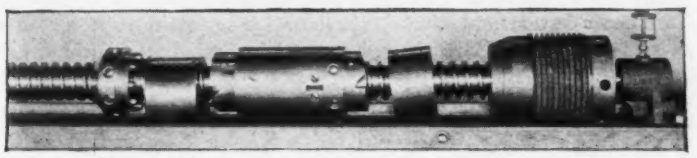
MODERN ELECTRIC SCREW ELEVATOR MACHINE.

The standard type of the screw electric elevator is now quite well known and has been previously described in THE ELECTRICAL WORLD. It consists generally of a heavy horizontally set main beam carrying a lower end screw bearing on top and with special castings at each end, one carrying a set of fixed sheaves and the other forming a yoke for the motor and supporting the thrust bearing, inboard shaft bearing, and brake. In the latest machines the commutator end of the motor shaft projects inwardly through a bearing in the yoke casting, and is coupled direct to the screw shaft. The other end of the motor shaft projects through the thrust bearing at the outer end of the casting, the extension being fitted with a brake pulley flexibly connected to the shaft. The thrust bearing at this end of the casting consists of two hardened steel disc plates, one carried on the motor yoke casting and the other by the shaft. Between them is a perforated bronze plate with independently pocketed hardened steel balls arranged in a spiral, the entire bearing being enclosed and running in oil. The bearing at the opposite end of the screw shaft is used for support only. All strains between the roller thrust bearing and the roller nut are brought to bear by the tension of the hoisting rope on the crosshead sheaves.

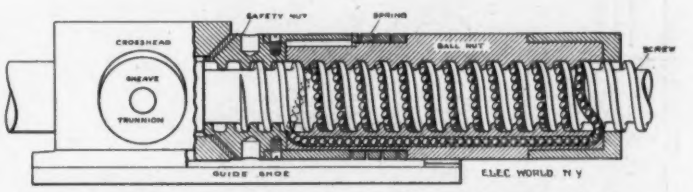
The prime and most unique features of the machine are the ball-bearing nut, safety auxiliary nut, and sheave-carrying crosshead. The nut proper consists of two parts, the ball-bearing section and the safety nut. There is no connection between the nut and the crosshead sliding on the main beam. The safety end of the nut simply joins the crosshead by a conical seat, which under ordinary conditions has enough friction to prevent a rotating movement of the nut. The contact between the transmission nut and screw is by means of a circulating chain of hardened steel balls, occupying about twelve threads. The balls, after circulating around the screw, pass from one end to the other of the thread through a tubular passage in the nut. In hoisting or lowering pressure is always exerted upon these balls. It is this feature, as well as the ball-bearing thrust and ball-bearing sheaves, which is particularly notable mechanically in this machine. The screw shaft is made of a special steel which is left untreated, and the balls by their continuous pressure and rolling action create a hardened surface on the threads of the screw after some use.

The safety nut is between the crosshead which is nearest the motor and the ball-bearing nut on which it is movably fitted, being pressed against the seat in the crosshead by a spiral spring between it and the ball nut, but normally not in contact with the threads

of the screw shaft. Several very important safeties are embodied in this particular construction, which may here be described. If for any reason the tension on the hoisting cables should relax, due to sticking of the car in descending, or, in fact, from any cause, the spring would force the safety nut forward, causing it to grip the screw shaft, and as the friction between its threads and the shaft would be greater than between the crosshead seat and nut, the latter would be revolved with the screw without effecting any

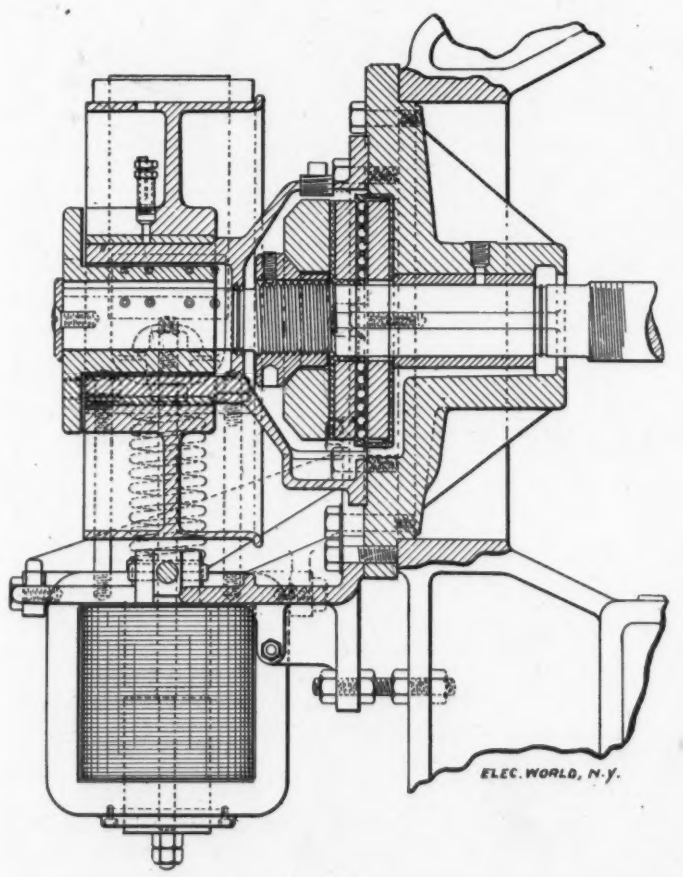


Screw, Safety, and Ball Bearing Nuts, and Buffer.

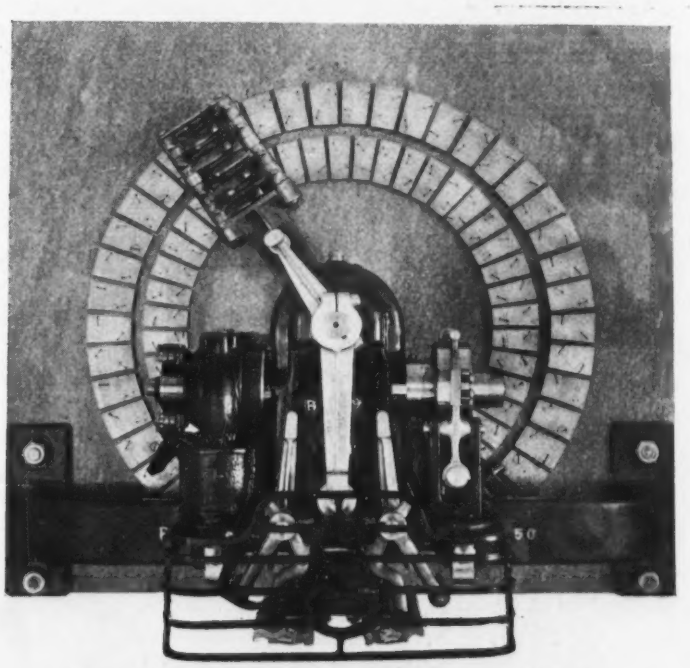


Cross-Section of Ball Bearing and Safety Nut.

straight line movement of the crosshead. If the ball bearings of the transmission nut are broken the safety nut is similarly forced into contact with the screw shaft by the pressure on the crosshead, effecting similar results. If the car should go beyond its ordinary limit of travel, causing the nut to reach the ascending limit of the screw shaft, a collar projecting through the opening of the crosshead bears against the safety end of the nut and causes it to revolve with the shaft. It is also to be noted that in descending the far end of the ball section of the nut strikes against a rubber buffer at the lower end of the shaft, making further movement impossible. These mechanical safeties are, however, not intended to act ordinarily; other electric safety and limit



Details of Thrust Bearing and Electric Brake.

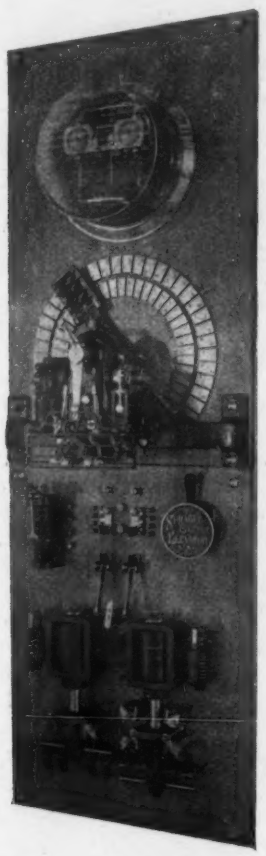


Pilot Motor, Main Resistance, and Pilot Switch.

stop devices are provided which obviate the operation of these mechanical stops, except under extreme conditions. Another peculiarly distinctive feature of this machine, and in which it resembles the hydraulic machine in general principle, is the operation of the motor in hoisting only, the car descending by gravity, and operating the motor in turn as a generator through a suitable resistance. Over-counterbalancing with this type of machine is practically impossible, for the reasons which have been stated. It is to be noted that the screw and nut system has so little static friction that a part of the counterweight can, however, be counterbalanced. The completed machines of the size most generally used in office buildings measure about 30 feet from end to end, for rises not exceeding 300 feet. This length is graded down to 21 feet for rises between 60 to 300 feet. The shaft of the 30-foot machine measures about 19 feet. Two methods of multiplying the cable movement are used. One of these is accomplished entirely in the machine by the use of the necessary number of multiplying sheaves on the crosshead and fixed sheave support. The sheaves are usually either 30 or 36 inches in diameter and work in ball bearings. This self-contained multiplication is used up to a ratio of 10 to 1. In this case the car counterbalance is hung free from the car. Where a larger multiplication is used, 16 to 1 being a frequently adopted ratio, one-half of the multiplication, or 8 to 1, takes place in a machine which is doubled by means of a multiplying counter-weighting arrangement in the hoisting cable.

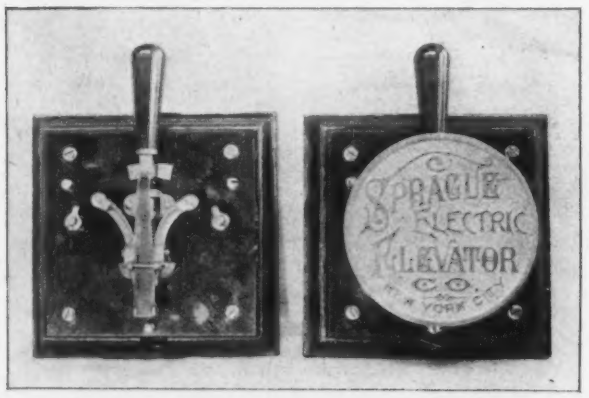
The motor used with these machines is of about 30-horse-power capacity. It is ironclad, of the four-pole type, with two salient and two consequent poles, and is compound wound, the series winding predominating. The frame is bolted to the yoke casting. The armature has a two-path winding, current being taken therefrom by two 90-degree brushes. The brake at the outer motor end of the machine is electrically controlled and is used only in stopping. A steel wood-lined band is anchored at one end; the other, after encircling the previously mentioned brake pulley is pulled down by a spiral spring whose action is counteracted by a peculiarly constructed electro-magnet. In addition to the mechanical safety devices embodied in the nut, other electrical safeties are directly fitted to the hoisting mechanism itself. These include an upper and lower limit stop and a centrifugal speed governor, and co-operate with the controlling apparatus, which is separately mounted on a suitable switchboard. Both the upper and lower limit stop switches are mounted on the side of the main beam, and operated by projecting roller rods on the crosshead

when it reaches either limit of its travel. The upper limit switch is normally closed, and when moved by the crosshead opens the main circuit; while the lower limit switch is normally open, and when closed by the crosshead short-circuits the motor through a graded resistance, which is gradually decreased by the further



Electric Screw Elevator Switchboard.

movement of the switch arm. The monitor centrifugal speed governor is fastened to the motor yoke, and controls a switch which is normally closed. This operates when the speed for which the governor is set is reached, this being usually something less than the setting of the car centrifugal speed governor, to release the brake and put retarding friction on the motor. The control of the main motor from the car is by means of a small pilot motor, which is operated in either direction by means of a car switch, suitably connecting either of its differentially wound fields. This motor by its operation controls the main motor



Car-Controlling Switch.

resistance. The general principles of this method of control have been previously described, but in its perfected form the breaking of the main circuit is now accomplished by separate electro-magnetic devices, thereby preventing any injury to the main rheostat from undue sparking.

The various controlling devices, including the pilot motor, main resistance, etc., are mounted on two slate panels, which are set in sections one above the other, forming a switchboard, or controlling panel for each individual machine. The upper panel usually carries the pilot motor and main resistance, and also the controlling switches operated by the pilot motor, while the lower panel contains the main switch, main circuit-breaker, auxiliary circuit-breaker, throttle, brake release and a car control and throw-over switch.

The general arrangement of this switchboard will be seen both from the diagram and the illustration. The main motor resistance is composed of two parts, one used for hoisting and the other

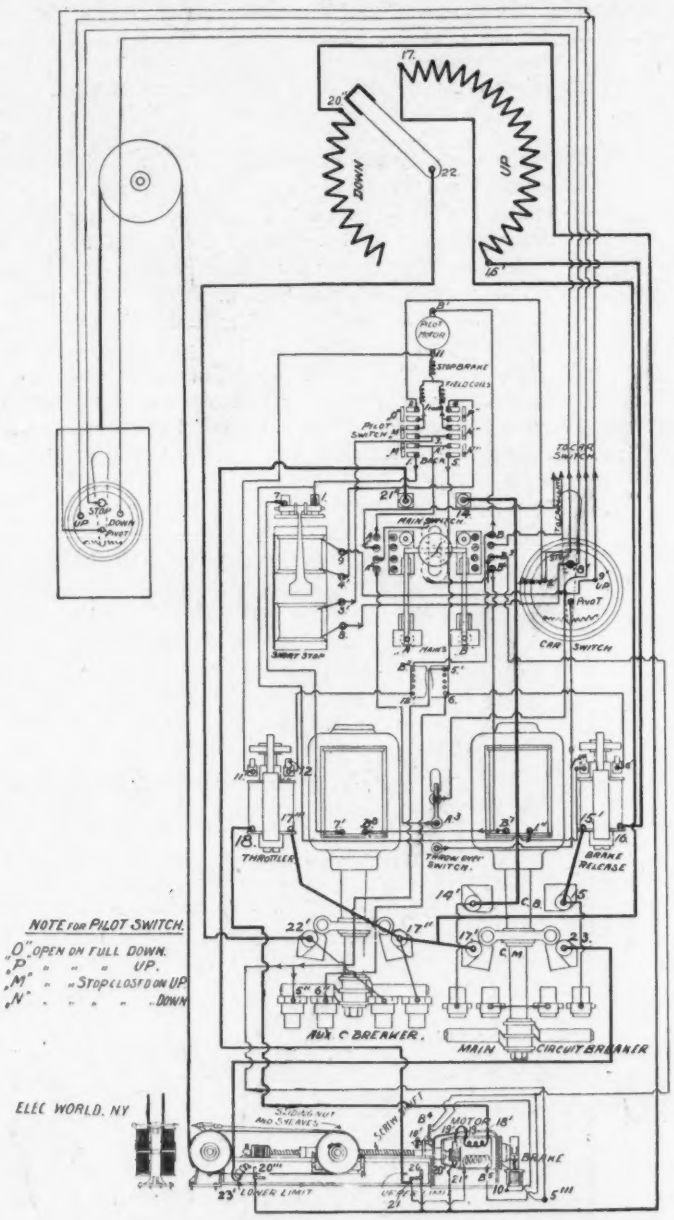


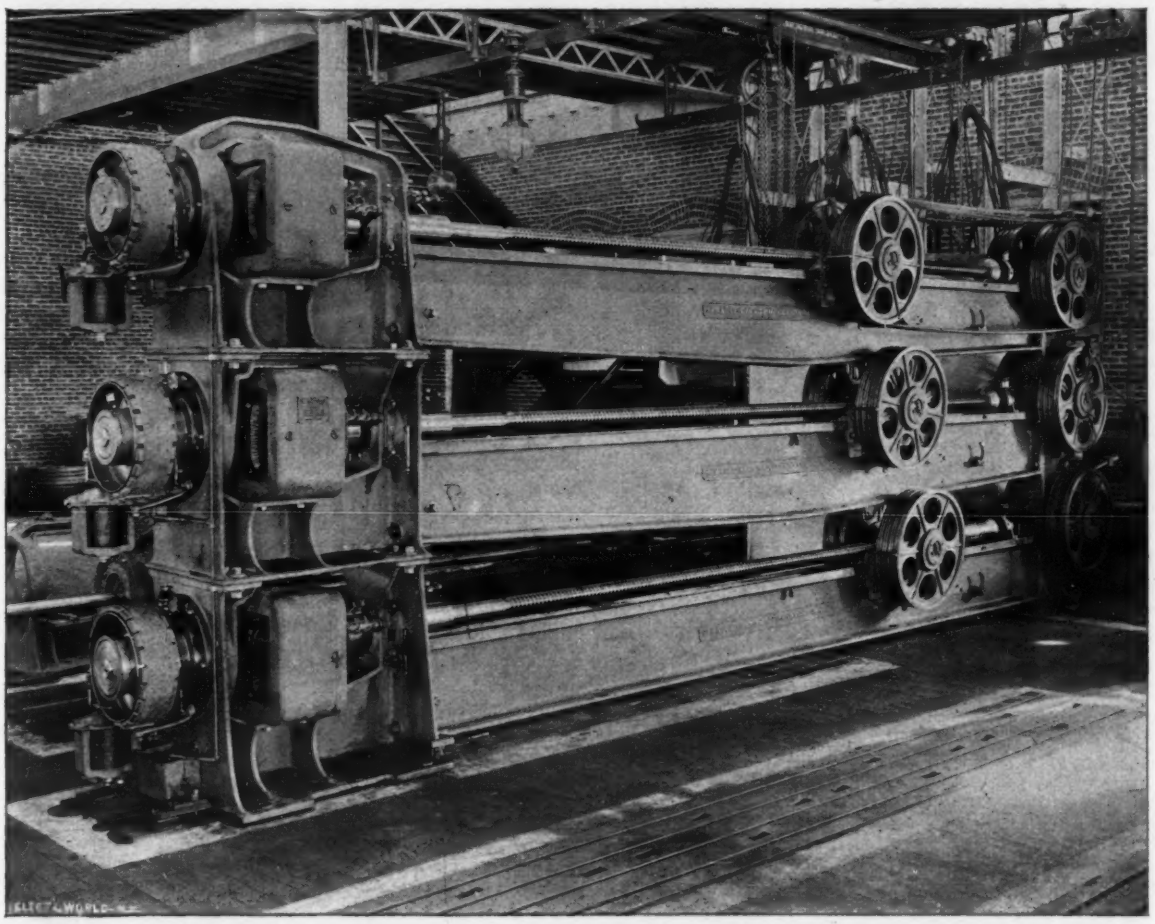
Diagram of Connections and General Arrangements, Screw Electric Elevator.

for lowering, each of which is made up of peculiarly shaped iron grids of various sizes, arranged in circular form, connected to copper contacts on the front of the slate panel. Over these contacts passes a heavy copper brush contact arm. The resistance is cast of a special composition of iron having a resistance nearly the equivalent of German silver. The arm which passes over the contacts is attached to a shaft which is rotated by means of a worm gear on the small pilot motor shaft. This pilot motor shaft is peculiar in that it is supported in the casing holding this gearing without any other bearings, projecting on each side thereof and being fitted on one end with the armature of the pilot motor, while on the other is fitted a small brake pulley. The latter is clutched by a small shoe brake controlled by an electro-magnet beneath the pulley releasing the brake when energized by the current.

The motor itself is of the horseshoe bipolar type, each core and pole piece being directly mounted on the casting supporting the entire arrangement.

Attached to the other end of the shaft to which the main resistance contact arm is fitted, are two fixed arms which are rotated with the shaft. These arms operate four switches, two on each side. These switches are of peculiar construction, and will be best understood from the illustration. The long arm when moved in either direction operates one of the switches which controls several contacts corresponding to N″ N″ and M″ M″, depending upon whether it is intended to go up or down. The short arm strikes the projecting arm of the other switches O″ and P″ on either side, when the limit of the rheostat contact arm travel is reached. The peculiar action of these switches will be described later.

The lower section of the switchboard is equipped with a main automatic release switch, to which the main circuit is brought, which is held in contact by a magnet and released by any rupture of the circuit de-energizing this magnet. The main circuit-breaker consists of a magnet controlling suitable switch contacts which close the main circuit through the hoisting motor. It is operated by one of the pilot motor controlling contacts. The auxiliary circuit-breaker is controlled by the so-called short-stop, and throws all the starting resistance in circuit with the driving motor, at the same time cutting in resistance in the brake circuit, causing the car to make an easy stop. The auxiliary circuit-breaker is similar to the main circuit-breaker consisting of a magnet operating suitable switch contacts. The short-stop consists of a pair of solenoids, acting at opposite ends of an iron core and controlling a switch contact lever. One of the solenoids closes the contacts, while the other opens them. The contact switch of the short-stop operates the auxiliary circuit-breaker. The car switch on the board is the counterpart of the car switch in the car, and by means of a small throw-over switch located in the centre of the lower section of the board either of the switches can be thrown into circuit. The car switch has three contacts and a pivoted handle which can be moved to either side of a central position into contact with either the up or down clips, and when brought back to its central position it is in contact with the stop clip. It may be lifted off the stop contact by the operator. The lever always returns to the stop position if released, thereby assuring a stopping of the car in such instances. The brake release is a small solenoid acting upon an iron core and operating a pair of contacts, which control the circuit of the brake. The throttler is set for a certain predetermined current, and when a sufficient main current passes through its solenoid coil it acts upon the core, which in turn shunts a resistance across the pilot motor, causing it to move more slowly. The general connections of the entire system are shown in the diagram which shows the various devices at their normal position with the car at rest.

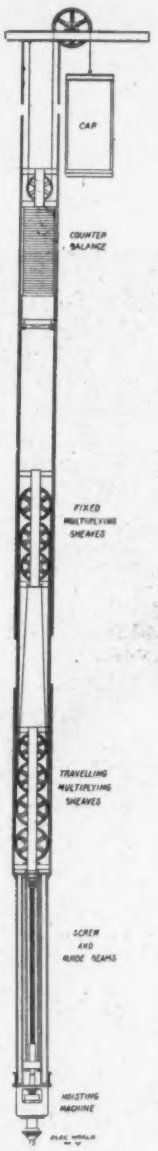


A TRIPLE DECK ELECTRIC ELEVATOR MACHINE FOR THE COMMERCIAL CABLE BUILDING, NEW YORK CITY.

The contacts on the pilot switch are set as indicated in the note. By closing the main switch current is thrown on to the various wires on the board, each circuit being fused from the main switch, which is held into contact by the shunt magnet. Any rupture of the current supply de-energizes this magnet and allows the main switch to open. The throw-over switch is shown connected to the operating switch in the car. If it is now intended to go up the car control switch arm is moved to the up contact, causing the current to pass from one side of the main supply switch to the central point of the throw-over switch, the contact arm of the car switch, through the upper coil of the short-stop, to one contact of the pilot switch, which is normally closed, thence to one of the differential pilot motor field windings and armature, and back to the other side of the main switch. This operation causes the pilot motor to rotate, cutting out the main motor resistance; at the same time, however, the two normally open contacts on the other side of the pilot switch have been closed by the movement of the long arm on the rotating contact arm shaft. This causes the current to flow from the main line to one pilot switch contact, to the main circuit-breaker coil, and back to

the other side of the main, energizing the circuit-breaker coil and lifting the contact arm, thereby closing the main circuit from one side of the main switch to brake release coil (which energizes the brake magnet and lifts the brake), to main resistance, to contact arm, auxiliary circuit-breaker switch, which is down, throttle coil, series field and armature, upper limit, and back to the other side of the line.

The main motor then rotates, moving the nut toward the up limit, and consequently raising the car. The speed may be adjusted by either keeping the up pilot motor circuit closed through the car switch until all the main resistance is cut out, or just a slight contact may be made and then broken, in which case the pilot motor stops, after lifting the contact arm to any intermediate position. When the resistance has been cut out and the main motor fully accelerated, the small arm on the contact arm shaft has struck the up pilot switch arm, which has remained closed, but is now open, preventing the further operation of the pilot motor on the up side. When the car reaches its upper limit of travel, the up limit switch is opened by the movement of the crosshead, thereby rupturing the main circuit, stopping the motor and applying the brake through the medium of the brake release. If it is desired to stop at any point, the car switch lever is brought to the stop contact, sending current through the lower short-stop coil, pilot switch contacts, which were previously closed by the long arm, to the opposite field of the pilot motor, and back to the main line supply. The pilot motor now rotates in the opposite direction, cutting in the main resistance again, bringing the contact arm back to its normal position, and opening the previously closed contacts on the pilot switch. As soon as the pilot motor has started to rotate from its set position, it has permitted the up contact of the pilot switch to return to its normal closed position. Immediately when the stop contact is made in the car switch the lower short-stop coil is energized, thereby closing its switch and sending current through the auxiliary circuit-breaker coil which pulls up its switch arm, cutting off the main resistance contact arm connection, and inserting all the resistance in the main motor circuit and also inserting resistance in the brake coil circuit, causing it to grip tightly. The auxiliary circuit-breaker is energized until the main resistance contact arm has returned to its normal position and opened the pilot switches, when the coils of both the auxiliary and main circuit-breakers are opened, causing them to drop back to their normal position. The return of the main circuit-breaker switch short-circuits the motor, which is the normal condition when at rest. Below the main circuit-breaker contacts is a carbon shunt break across the main current supply contacts, which takes the sparking away from the main contacts above. Below the main contacts of the auxiliary circuit-breaker is a similar shunt arc breaker, and also a switch controlling a resistance in the brake circuit, which is short-circuited when the auxiliary circuit-breaker is inactive, thereby permitting the maximum flow of current through the shunt brake.



Vertical Electric Screw Elevator.

It will be noticed that the shunt field is permanently connected across the line after the main switch has been thrown in. When the auxiliary circuit-breaker is down, while the car is going up, current passes through the centrifugal governor switch and brake magnet coil and the lower left-hand brake contacts on the auxiliary circuit-breaker to the brake release switch, thence to the pilot switch contacts back to the other side of the line. In stopping the main resistance is included in the circuit of the main motor, slowing its speed until the main circuit is ruptured at the main circuit-breaker and the motor stops and the brake is fully applied.

In descending the down contact is made at the car switch, sending current through the opposite single closed pilot switch and pilot motor field and armature and back to the line. The pilot motor now rotates in a down direction, this action at once closing the pilot switch opposite to that previously closed by the long arm as indicated. The other or dynamo side of the main resistance is now thrown across the main motor terminals, the resistance being gradually increased by the moving of the contact arm. The main or auxiliary circuit-breakers are not actuated and therefore no current is supplied from the main line. The car descends against the dynamic action of the motor, which acts as a dynamo through the resistance, which is gradually increased, accelerating the speed of the descending car, if the pilot motor armature is permitted to rotate until it comes to a stop, by cutting out the single down pilot switch previously mentioned; the pilot motor may, however, be stopped at any intermediate point, as on the up side. If it is desired to stop the stop contact is again connected, moving the contact arm and switches back to their normal position. When the car has reached its lower limit of travel the crosshead and multiple sheaves strike the lower limit switch arm, thereby short-circuiting the motor through the resistance of the lower limit, and loading it so that it decreases in speed. The brake coil on the down trip is directly energized by the closing of the double down pilot switch and applied again when this switch is opened by the return of the long arm to its normal position.

The action of the throttle, which acts in hoisting or lowering, is exceedingly interesting. This instrument is set at a predetermined current, which when exceeded shunts a resistance around the pilot motor, thereby causing it to move more slowly and inserting or cutting out the main motor resistance correspondingly, whichever may be the case. It will be seen that the pilot motor brake coil is in series between the armature and both differential field coils of the pilot motor. The action of these devices is exceedingly interesting and unique, taking care of almost any condition. The use of separate magnetic switching devices to control the various circuits confines the arcing to the switch contacts instead of to the main resistance.

In the largest installations of this type of machine, where several are operated together, the grouping together of a number of separate machine panels forms a very elegant switchboard, which is frequently equipped with a recording wattmeter and indicating instruments. In such installation the machines are sometimes banked one on top of the other, the latest production in this direction being a triple-deck machine. Each of these individual machines is exactly alike and is operated as described. They are set one on top of the other to save space, which is accomplished in a very neat manner. Up to the present time the multiple sheave electric elevator has been constructed to operate horizontally, but the very latest development in this direction brought out by the Sprague Company is a vertically placed machine, operating in every way similar to the horizontal machine and intended to be located in exactly the same position as the ordinary hydraulic machine.

The features peculiar to this machine may be here noted. It will be primarily seen that this type of machine resembles the hydraulic in its action. A strong element of safety exists in the fact that the current in the field coils is never reversed, consequently the machine is never demagnetized. This is due to the operation in one direction only, and the gravity descent. The use of electro-magnetic switching devices assures a quicker and surer operation of the switches than would be possible by hand operation. The safety on the car itself has not been mentioned. In its general operation it is similar to the usual devices of this kind. It consists of a centrifugal governor operated by a standing rope. When the speed of this governor overreaches the set speed a lever is freed and the safety clamps are operated by a wedge, causing them to firmly grip the guides. It is also to be noted that the stop contact in the car affords a feature of safety, inasmuch as should the operator accidentally remove his hand from the controller switch the lever automatically returns to the stop position, preventing any further movement of the car. The monitor speed governor on the machine is simply used as a preventive against excess speed of the screw shaft and operates the brake circuit only. It is claimed that the entire control system is so positive in its operation that no matter whether the car is being hoisted or lowered, the brake band can be actually removed and the car still controlled.

Controlling the Speed of Car Motors.—III.

BY WM. BAXTER, JR.

The arrangements so far shown for obtaining a positive gradation of velocity in railway motors are not all the methods involving the use of a regulating motor or generator that can be made practical; in fact, there are many more than those shown, and some that might be regarded as superior to them, but it would be an unnecessary waste of time to undertake to describe every conceivable arrangement, as the three considered are sufficient to demonstrate that along this line, alone, it is possible to find many solutions to the problem which we would be made to believe presents very serious, if not insurmountable difficulties.

There are many men who regard the use of any mechanism, even of the simplest kind, as objectionable, on account of the added complication, and to such, the methods discussed in the foregoing may appear as undesirable from the fact that a machine is required to effect the regulation. As this machine could be made small, and thoroughly reliable in its action, the objection would not be regarded as a good one by most engineers, but, as it is possible to obtain the same results without the use of mechanism, it is better to show how this can be done than to show that the objections that may be raised against the mechanism are not well founded.

By the use of storage batteries, regulation can be effected either by placing them in the car circuit in series with the whole motor, so as to absorb or add to the E. M. F.; or they can be located in the field circuit, so as to govern the speed by varying the field magnetism. Fig. 5 shows the first arrangement, and, as will be seen by following the lines representing the connections between the cells and the switch *S*, the battery can be placed in the circuit either to assist the main current or to oppose it, by simply moving the lever in one way or the other. If the total E. M. F. of the battery is 200 volts, and the line pressure 500 volts, when the former is connected in opposition to the line, and is being charged, the voltage available for the car motors will be about 300, and when the connections are reversed, and the battery is discharging, the pressure will run up to about 700 volts, thus giving a regulation over a range of more than one-half the pressure, with a battery E. M. F. of two-fifths that of the motors. With this amount of variation the speed of the car could probably be changed over 60 per cent.

The advantage of this arrangement is that the relation between the armatures and the fields of the car motors will remain the same

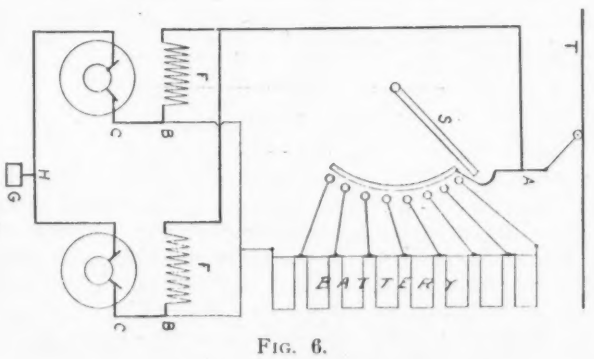


FIG. 6.

for all current strengths, and although this, as has been already shown, is not a decided advantage, it is so regarded by some engineers, and therefore from their standpoint it would go far toward offsetting the principal objection, which is that the battery would have to be of considerable size. The size of the battery, however, would be large only in comparison with that required to regulate the field current, but when compared with a battery of sufficient capacity to furnish all the current supply, it would be small.

In Fig. 6 the battery is placed in a circuit that shunts the field coils *FF* of the car motors. The number of cells would have to be sufficient to develop an E. M. F. greater than the drop between the points *ABB* when the maximum current flows from the line. Under these conditions if the switch *S* were turned to close the circuit the predominance of the battery would send a current into the line which would pass from *A* to *BB* and thus increase the magnetizing force of the coils *FF*. In this way the motors would start with a very strong field, and at a comparatively low velocity cut down the armature current to its normal amount. As the switch *S* is moved to cut out successive cells, the battery E. M. F. will drop and when it reaches a point where it just balances the difference of potential between *A* and *BB*, it will be inactive. The cutting out of more cells will cause the line E. M. F. to predominate and a current will flow through the battery in the opposite direction and charge the cells. In this way the field strength is varied by first adding the battery current to that from the line and then taking current from the line to charge the battery. The advantage of the arrangement over that shown in Fig. 5 is that the battery can be made very much smaller, as it only has to produce a variation in the field current. The objection to it is that in addition to the battery, a resistance would have to be placed in the motor circuit to cut down the current in starting, as otherwise there would be nothing but the resistance of the motors to oppose the line E. M. F. This resistance could be placed anywhere between *A* and *G*, but it would not be desirable to have it between *A* and *BB*, as it would then be in parallel with the battery and would offset the effect of the latter in strengthening the motor fields on the start. The best location for this resistance would be either between *BB* and *CC* or between *H* and *G*, preferably in the latter position.

It may be mentioned as an objection to both the plans shown in Figs. 5 and 6 that the cells of the battery are not all used to the same extent, and, hence, some would discharge much sooner than the others, but this difficulty can be overcome by changing the position of the cells at proper intervals, and by renewing them as often as those subject to the greatest strain require replacement.

In view of the unfavorable past history of storage batteries, in railway work, it may be believed by many that it is not safe to base any calculations upon their use, but to this it may be said that in point of durability, decided improvements have been made within the last few years, and this is really the only point that should be considered in connection with them when employed in the manner here described. Their efficiency need not be taken into account because the amount of energy put into and taken out of them would be but a small portion of that required to operate the car, even in the arrangement of Fig. 5, since the normal position of the switch would be that shown in the diagram, in which the battery is out of circuit. A very small movement from this position either up or down, would make a considerable change in the speed of the car as the upward movement would cut in cell that would help the line E. M. F. and the downward movement would cut in the cells to counteract it; therefore, in so far as speed graduation is concerned, one cell effects a variation equal to twice its E. M. F. While the capacity of the battery might be from one-fourth to one-third of what would be required to run the car, the amount of work done by it would not be over a few per cent. of that amount, as most of the regulation of the speed would be accomplished by a comparatively small movement of the switch to either side of the central position, and it would only be on rare occasions that a large number of cells would be brought into use.

In conclusion it may be added, that the fear that the armature reaction can become so great, in all cases where the speed is regulated by varying the strength of the field, as to cause destructive sparking on the commutator, is groundless. For any given duty, the motors would be so proportioned that the maximum velocity would be obtained against the minimum head resistance, with a strength of field amply sufficient to counteract the armature reaction; and regulation would be from this maximum velocity down, and not up; hence, the variations in field strength would act to reduce the effect of the armature reaction at all velocities below the highest. The only exception to this condition would be when it became desirable to increase the horizontal effort beyond that corresponding to the speed; but in all cases, except when the velocity is at the maximum, a considerable increase in the effort could be made before the effect of the armature reaction would become noticeable. Even at the maximum velocity, a considerable increase in the horizontal effort could be made without serious results; but although this is true, the fact would seldom be taken advantage of, as it would amount to overloading the motors. At any speed lower than the maximum, the increase of effort beyond the normal could be made still greater, because, at these velocities, the armature current could increase quite considerably before the relation between the armature and field magnetization would become the same as at the maximum, and to this increase in armature circuit could be added all the increase permissible at the highest velocity.

From a consideration of all these facts it must be conceded that, so far as speed regulation is concerned, the electric motor can be made to meet the most exacting requirements, and if it is to fail in its efforts to do the work of the steam locomotive, it must be through a weakness in some other direction.

The Telephone in the United States.

In his report to the stockholders of the American Bell Telephone Company, covering the year ending December 31, 1896, President John E. Hudson makes some very interesting statements regarding the telephone service in the United States. In all there are thirty-two companies reached, whose systems furnish long-line terminals. These companies have a total of 259,198 stations, of which 105,091 are connected by metallic circuit. Isolated exchanges are steadily becoming less in number. The great system of interconnecting links, linking together the small cities and towns as well as the important commercial centres, has brought many millions of people within the possibility of speech over long distances by telephone, and the subscriber of to-day, at most of the exchanges, Mr. Hudson states, finds himself not only furnished with the facilities for talking with others in the same locality, but able to command, almost on the instant, the service of lines over which he may, within the time allowed for a toll line connection, hold a conversation of several hundred words with his correspondent at a distant point. The United States, Mr. Hudson asserts, still holds the leading place among the great nations of the world in the development and use of the telephone service. It is a noteworthy fact that the number of exchange stations operated by the licensees of the Bell Company about equals the aggregate of stations of all the countries of continental Europe, having more than five times the population of the United States. There is a concurrence of evidence, Mr. Hudson states, that in the United States the telephone service has been brought to a higher standard of excellence and efficiency than elsewhere, and to this fact must be attributed in great part the general use into which the system has been brought for the transaction of business and for household conveniences.

Mr. Hudson makes a very brief reference to the suit of the United States against the American Bell Telephone Company, et al., which is now before the Supreme Court of the United States. The appeal from the decision in favor of the defendant by the Circuit Court of Appeals of the First District, was argued November 9-11 last. Mr. Hudson's report simply states that the court has not yet rendered its decision.

Birmingham (Eng.) Electric Railways.

Of late a number of the English municipal authorities have been sending sub-committees and deputations to various towns on the Continent to inspect the various electric railway systems in operation there, for the purpose of deciding upon the method most suitable for their own districts. Such deputations have recently hailed from Belfast, Glasgow, Sheffield and other places, and in all cases the parties have returned thoroughly convinced in favor of the overhead trolley system, so that many electrical men have thought that the decision of any and all deputations would follow in the same course and make similar recommendations. The Birmingham municipal authorities have not done so. A committee has just returned from a continental tour, its object being to ascertain what system of electric traction it should permit the Birmingham Tramway Company to construct in its city and suburban thoroughfares. It will be remembered that at this town the company has been trying on various sections for some years four systems—cable. horse, steam and the electric accumulator system. The latter section has been financially unsuccessful, and the new company which will put down a much more extended service of lines, proposed equipping the entire system on the overhead trolley method. It was for the purpose of inquiring whether such should be allowed that the corporation sent a deputation to the Continent. The party which has just submitted its report, has somewhat naturally only considered the questions of safety and convenience, leaving the important item of cost out of consideration, as that is a matter for the railway company. Its recommendation, therefore, is that the company shall put down a conduit system. What effect this decision will have upon the scheme, which is a very large one, as far as English schemes go, cannot yet be conjectured, but it is interesting to note that a deputation going from Sheffield—a very similar city in many ways—which had to consider cost and every other point as well, has led its corporation to adopt the overhead trolley.

Insulation for High Frequency Currents.

To the Editor of The Electrical World:

Sir:—The question of insulating high-frequency currents has been one of so much interest that I am impelled to give my own experience in the matter.

Believing, with many, that oil was not a practical insulator for office use, I at first tried the various forms well known in induction coil work. All, however, proved to be entirely useless, as great loss of current was apparent from the very beginning, and a few hours' use only served to break the insulation down completely. My attention was then called to pure paraffine, which we applied hot and in a vacuum. This served admirably for a time, and I was inclined to believe my efforts had been crowned with success. In two days of constant use, however, the discharge commenced to be more flashy. This continued until the third day, when the insulation gave way entirely. This experiment was several times repeated with no better results. As a last resort I then turned to oil. After carefully testing many samples and winding my coil with special reference to that form of insulation, I then mounted the high-frequency coil, which has been in use ever since. After eleven months of almost constant use in the manufacture of Crookes tubes, the length and character of the discharge or consumption of current have not materially changed. During that time the oil has not been renewed, and there is not, apparently, the slightest indication of gumming.

If my experience has been different from that of others in this particular I shall be pleased to present substantial evidence of the truth of the condition above mentioned.

In view of this fact, I am forced to believe that oil is the only practical insulation for this work. E. Cate.

Boston, Mass.

Electric Tachometers on Warships.

In the French navy experiments are being tried on the battleships "Marceau" and "Courbet" and upon the cruiser "Le Suchet," for indicating the speed of the engines and their direction, by an electric method, giving indications in various parts of the ship. A small dynamo is used, geared to the main shaft in each case, and furnishing current to mains connected with galvanometers of a peculiar design, in various parts of the vessel. These by the amount and direction of the displacement of their needle indicate the speed and direction of the engine shaft.

Testing Insulators.

In a recent discussion in a London society Mr. Mordey described a very simple method of weeding out faulty insulators. All the insulators are turned upside down in a tray of water and are filled with water, into which is held a copper wire connected to one pole of a dynamo, the other pole being connected with the tray containing the water. After running a few hours the water in the faulty insulators will be colored blue according to the amount of leakage. Those showing no coloration of the liquid can safely be used.

General Grade-Crossing Bill.

The New York State Senate has passed a general grade-crossing bill, appropriating $100,000 each year to pay the State's one-fourth of the expense of changing present grade crossings to overhead or underground systems. The counties benefited are to pay one-quarter of the expense and the railroads the other half. When a new road is opened the railroad pays one-half and the municipality one-half, and where a new railroad is built the railroad pays the whole expense.

Possible Physical Experiments.

In a long paper by Fournier d'Albe, published some time ago in the London *Electrician*, he concludes that the total number of possible physical experiments is only 3200, and that over 2000 of these have already been performed, leaving but little more than a thousand for future generations of physicists.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculating the Hysteresis Energy in the Teeth of Armatures. BRESLAUER. *L'Ind. Elec.*, March 25.—A French translation, in abstract, of the article noticed in the *Digest*, March 6.

Motor Regulation. ANTHONY. *Elec. Eng.*, April 14.—A reply to the criticism of Blood, (see *Digest*, April 10). He claims that Blood is absolutely in error; he explains the original experiments and gives some diagrams; it appears that a six-pole machine was used, that the armature was multipolar and that three of the poles in one half were alike and opposite in polarity to the three like poles in the other half; he claims that none of the patents cited by Blood describe this method.

LIGHTS AND LIGHTING.

Incandescent Material for Incandescent Lamps.—Elek. Anz., April 1.—A short article giving more recent results (presumably referring to the article abstracted in the *Digest*, Dec. 14, 1895) obtained by Schnabel with a new refractory conducting material. The chief properties of this material (a carbide?) are that the temperature to which it can be raised seems practically unlimited; vaporization does not take place at 3000 degrees, but it liquefies at 1900 degrees; it forms absolutely no combination with atmospheric air or even with oxygen; the light given from it required only one quarter of the energy of that in the usual incandescent lamp, is absolutely white and has no excess of violet rays; with four volts and four amperes 20 candles were produced; the weight of the material is one quarter of a gram; the price of a kilogram is 6 marks ($1.50); it is in the form of powder; the lamp is constructed of a plate of marble with a groove in it having an enlargement in the centre for the material, the conductors being carbon. Later results obtained within the past year are also given; with increasing temperature the current decreases rapidly; the resistance of this conglomerate as compared with carbon is as 1 to 15, but it can be reduced by changing its chemical constitution; a change of weight could not be detected during a period of 600 hours during which vaporization, if there were any, would have taken place to an appreciable amount. A table giving the temperature, candle-power and consumption of energy is given, as also the increase in efficiency and the energy in watts per candle; the latter begins with 0.80 at 2200 degrees and reaches a minimum of 0.50 at 3200 degreees, after which it increases again; the light efficiency of this mass, therefore, approaches closely to that of the arc lamp.

Mining Lamp. SUSSMANN system. *L'Eclairage Elec.*, March 27.—A brief description with illustration of this lamp which has been used experimentally in some Belgian mines and has proved to be thoroughly satisfactory. It consists of an accumulator with a gelatinous electrolyte, and a small incandescent lamp attached; there are two negative and one positive plate; the box measures 125 x 65 x 65 mm; there are two cells connected in series: a reflector concentrates the light in one direction; the weight is 1.95 kg, and it will run the lamp from 12 to 16 hours; it is thought that its capacity might be increased or the weight diminished; the light is 2.5 to 5 times that of the usual miners' lamp, the comparison being made with a well-cleaned oil lamp, although that is not their usual condition; for an equal weight the luminous intensity will be from 1.5 to 3 times that of the usual miners' oil lamp; it has the additional advantage that it can be used in all possible positions.

Arc Lamps. RICHARD. *L'Eclairage Elec.*, March 27.—A continuation of his long series of illustrated descriptions, taken apparently from patent specifications, and which have been noticed occasionally in these columns.

POWER.

Long Distance Transmission of Power. ESSON. Lond. *Elec. Eng.*, April 9.—The conclusion of his long paper (see *Digest*, last week). He continues the discussion of the line and its calculation, giving some tables for facilitating such calculations, one giving the currents per break up for various voltages, another the volts lost per mile at different densities, and the third the sizes of conductors at various currents for different densities; the question of self and mutual induction of the line wires is not considered, in many cases it is not negligible. He then discusses motors, pointing out the well-known differences between the synchronous and the non-synchronous types, describing methods of starting the former, and concluding that for general work the induction motor is much superior; the chief qualities for a good motor of this type are discussed; transformers are not considered. In conclusion he favors the two-phase system as distinguished from the three phase, especially where lighting is combined with power, as the saving in copper for the latter is such a small fraction of the whole cost that it is hardly worth considering; the difficulty due to the uneven loading in the three-phase system is peculiarly objectionable; for transmission of power in large units the three-phase system is well adapted. In the discussion Mordy, among other things, stated that experiments with the forms of curves have mostly been made in colleges with machines running light, and recommends that such tests be made on working circuits from central stations on which lights are also run, and he thinks that a considerable change in the wave form would then be found; he did not agree with the author that for power work where good regulation was required, single wound field magnets were not as much used as separate magnets; the former are used on the Continent, and it is a mistake to suppose that they are not as good regulators as machines wound with separate magnets; regarding insulators, he describes a useful method of testing for finding the faulty ones; they should be turned upside down in a tray of water, the cups being filled with water into which is held a copper wire connected with one pole of a dynamo, the other pole of which was connected with the tray; after running a few hours the water in the faulty insulators will be colored blue, according to the amount of leakage; those showing no coloration could be safely used. Siemens stated that in his opinion it was still an open question whether the alternating-current system was the best for power transmission; he had used both and favored the continuous current.

Electrical Driving in Shops.—Lond. *Elec. Rev.*, April 9.—An abstract of a recent paper by DIXON before the West of Scotland Iron and Stee Institute, calling the attention of iron and steel works to the advantages of electrical driving, and citing as an example the New Duquesne Steel Works in America. He examined in detail power plants comprising nearly 50,000 hp on the Continent; in America it is estimated that there are 500,000 motors in 10,000 installations, and some 15,000 hp in New York City alone; he discusses chiefly the saving in the power.

Electric Hoist in Deep Mines.—Eng. News, April 8.—An illustrated description of the 125 hp hoist at the Free Silver Mine, Colorado, which is believed to be the largest electrical hoist in the world.

Elevator.—West. Elec., April 17.—A brief illustrated description of a new type of elevator used in the Trude Building in Chicago.

Fans and Ventilating Outfits.—Elec. Age, April 10.—The greater portion of this issue is devoted to illustrated descriptions of a large number of fans.

Shop Cranes. GRIMSHAW. *West. Elec.*, April 17.—Brief illustrated descriptions from *Machinery*, of a semi-electric and other shop cranes.

TRACTION.

Mixed Trolley and Accumulator System at Hanover. ROSS. *Elek. Zeit.*, April 1.—A long, well illustrated description with results of tests of this system in which the accumulators are charged on the outlying portions of the line where the overhead system is used, and are discharged on those portions in the city limits where the overhead line is forbidden. A brief description is given; there are 21.4 km on which the trolley system is used and 17.7 km on which the accumulators are used; the charging of the battery proceeds continuously on the outlying portions, the lengths of which vary from 2.8 to 8 km, and are discharged over portions varying from 5 to 12 km; a car with a seating capacity of 20 contains 208 accumulators weighing 2600 kg; a diagram of the car wiring and of the controller connections is given. When the accumulators are discharged they are divided into two halves, which are connected in parallel and are then used with the first five points of the controller, while at the sixth point the batteries are connected in series, as they are during the charge. Extended tests were made, the results of which are given in curves; readings were taken every five seconds; a mean was obtained of 484 watts per car kilometer unloaded, with a mean speed of 4.4 m per second and 484 watts at a speed of 3.94 m per second when the car was loaded, both of which results are thought to be somewhat too high; the friction coefficient was obtained by cutting off the current and noting the reduction of the speed, the test being made in both directions; the formula for calculating the coefficient is given. Similar tests were then made on the portions on which the accumulators were used, and a mean of 380 watts per car km at a speed of 2.6 m per second, including stops, was obtained; the appreciably smaller consumption was due partly to the slower speed, but chiefly to the unfavorable efficiency of the system used on the overhead portion; the curves show that it is possible to run with the battery in parallel during the greater part of the trip, and this has an important and material effect on the capacity; with a mean of eight charges and discharges, an efficiency of

74 per cent. was obtained for the battery; this was under favorable circumstances, but ordinarily 70 per cent. may be counted upon; an automatic alarm indicator showing when the battery is fully charged is needed and is forthcoming; any lack of charge is made up in the evening; in the later form of cars the batteries will have a capacity of 25 ampere hours at a one hour rate (in the older cars the capacity was 20 ampere hours); during regular work only about 25 per cent. of the battery capacity will be used, the reserve being for emergencies; complete tests are being made and will be ready in a few months. The efficiency of the motor was also tested; at present, during the greatest part of the time, the motors are running very inefficiently. The results obtained at the power station are briefly discussed, and it was found that the battery had a very favorable effect on the station, as it acted as a reservoir and enabled the engines to be run more economically. The tabulated results of the operation for the past year are given; although the consumption in watts is somewhat higher than on some overhead lines, the consumption of coal is more favorable; the cost of maintenance of the batteries is briefly discussed and it is found that during the last year the total cost of maintenance, not including interest and depreciation, was about one quarter of a cent per car km, the battery cars at the end of the year having run 24,000 km. In his conclusions he expresses a belief that the use of the accumulators will not increase the total cost per car km by more than 1.25 cents; a comparison is then made with a slotted conduit system within the city limits, and this is found to be very greatly in favor of the accumulators; the extra weight of the cars does not seem to have had any bad effects on the rails; a choice between the accumulator or the conduit system on such mixed lines must depend on the conditions; in the operation the accumulator system is greatly to be preferred; the service is more elastic, and the accumulators serve a very useful purpose as a reservoir; in the case of a certain breakdown in the overhead line, the cars were run over the faulty section by means of the battery; general conclusions regarding the preference of the system cannot be drawn; for a short portion of a line, on which there is very heavy traffic, the conduit system might be the cheaper, but on the other hand, for longer portions on which the car frequency is not very great, the accumulator system would be the cheaper; under the conditions in Hanover there is no doubt whatsoever that this mixed accumulator system is much better than the conduit system would have been, especially in point of economy.

Recent Development in Electric Traction Appliances. Baylor. Lond. *Elec. Eng.*, April 9.—The beginning of a reprint, with illustrations, of an Institute paper in which he describes the general modern practice. In a modern plant the units are made as large as possible and the dynamos, with but few exceptions, are direct-driven; slow speeds have become the standards; an important development is the use of steel, instead of iron, for the field magnetic frames, which enables the construction to be much lighter; flexible couplings, although at first thought essential, have all been found useless and unnecessary, a properly proportioned fly-wheel being sufficient; a built-up type of fly-wheel is illustrated; there is now about 300,000 hp of direct-coupled machinery in regular and successful use.

New Overhead System. Bochet. *L'Eclairage Elec.*, March 27.—A brief illustrated description of the system mentioned in the *Digest*, March 20. (The length of the car and trailer would have to be equal to the distance between two posts, and would, therefore, have to be abnormally long).

Inter-Urban Car.—Elec. Eng. and *Elec. Rev.*, April 14.—An illustration of the car which is to be used on a Prussian railroad where electricity is to be used to replace steam; there will be 30 of these cars; the gauge is only 30 inches; there will be a motor on each axle.

Steel Work in a Modern Power House. Jones. *Eng. News*, April 8.—An illustrated description of the steel work in the new power house at Kansas City.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Harrogate.—Lond. *Elec. Eng.*, April 9.—A long illustrated description of this high-tension alternating-current system, with special reference to the steam engineering plant.

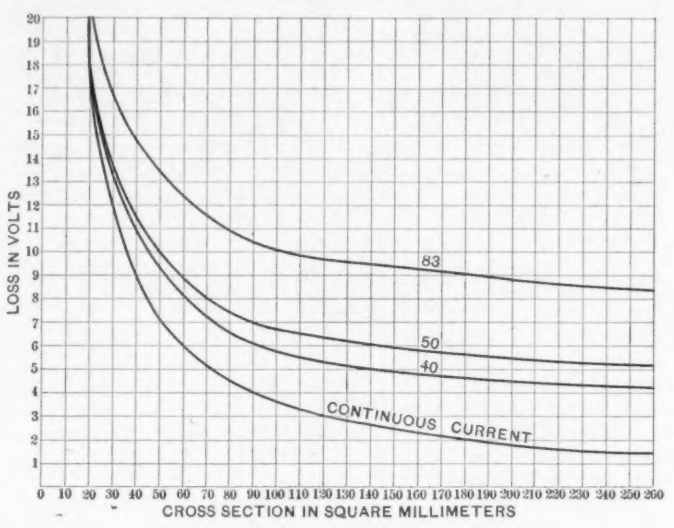
Storage Battery Engineering Practice. Appleton. *Elec. Eng.*, April 14.—A continuation of his serial. He discusses the subject of charging and its effect on the maintenance. A new battery will not give its full capacity for the first 20 or 30 discharges, during which time an overcharge of 25 per cent should be given at each charge by increasing the time but not the current; the charge should be kept at the normal rate or below it; the voltage and the specific gravity are the best gauges of the charge; at 2.5 volts with the current flowing the cell is practically full; the specific gravity is an excellent indication but the liquid should be stirred, preferably with an air pump; a curve shows how the specific gravity indicates the condition of charge; he considers it the best guide, and better than the voltage, which may rise due to internal resistance; better results can be obtained by reducing the charging current toward the end of the charge.

Montreal. Gossler. *Elec. Eng.*, April 14, and *Canadian Elec. News*, April.—A long, well illustrated description of the reconstructed alternating-current station of the Royal Electric Company in Montreal.

High Voltage Lamps in Central Station Practice. Addenbrooke. *El'ty*, April 14.—A reprint of the table noticed in the *Digest*, April 17.

WIRES, WIRING AND CONDUITS.

Impedance Factor and Fall of Voltage in Alternating-Current Circuits of Large Section. Picou. *L'Ind. Elec.*, March 25.—A short article in which he gives the results, in the form of the adjoining curves, of some very laborious calculations. The table formerly published by Kennelly stops



with wires 10 mm in diameter, and the present curves were therefore calculated for much greater sections, and for the more usual frequencies, in order to be of assistance in the very numerous applications of large alternating currents, such as in the manufacture of calcium carbide; the curves enable any one not familiar with algebra to easily determine the proper cross-section so that the loss in voltage shall not exceed a given amount. The table is calculated for a current of 100 amperes and a distance of 100 m (that is, a length of conductors of 200 meters); to use the curves to find the proper cross-section for a given current and a given distance of transmission, select a cross-section (presumably as near as possible to the probable value) and find the corresponding ordinate from the curve representing the frequency (the numbers 83, 50 and 40 on the curves refer to the frequencies); this ordinate will be the fall of voltage for 100 amperes at 100 meters; the true loss corresponding to that cross-section will then be equal to this value multiplied by the distance and the current, and divided by 10,000; if this loss of voltage is not satisfactory, another cross-section is selected and the operation repeated; if the desired loss in voltage cannot be attained it shows that it is necessary to modify the conditions, such as diminishing the distance or sometimes bringing the wires much closer together; the curves are calculated for a distance of 30 cm (about 12 inches), which is the smallest distance admissible for overhead lines. In conclusion he gives a small table of the impedance factor for various diameters and for the above-mentioned frequencies.

Rules and Regulations in Germany.—L'Elec., April 3.—The beginning of a French translation of the recently adopted rules.

Transmission of Large Currents. Zahn. *West. Elec.*, April 17.—A long article on the calculation of networks of leads for the usual lighting currents; he gives a number of formulas and tables concerning the safe carrying capacity of wires and cables, and describes with the aid of an illustration, a model for calculating the cross-section of mains forming a network, by means of mechanical measurements of stretched wires on which weights are hung, on the basis that a wire suspended at two points and loaded with weights is analogous to a wire to which a current is applied at its two ends and taken out at several intermediate points; the apparatus was devised by Helberger; the results are said to be quite satisfactory and the cost of the model is not prohibitory.

ELECTRO-PHYSICS AND MAGNETISM.

Electrification of Gases by X-Rays. Rutherford. *Phil. Mag.*, April.—A long paper describing further experiments with the way in which electrified gases can be obtained by means of Röntgen rays and to examine the properties of a charged gas and the opacity of gases. It is followed by a note by J. J. Thomson; he states that the connection obtained between the coefficient of absorption and the saturation current admits of the expression that the rays so far resemble light as to be of the nature of an electromagnetic wave or impulse; such a wave may be conceived as consisting of a group of Faraday tubes traveling outward through space, they being of equal strength and corresponding to the atomic charge carried by a univalent atom; the result may be expressed by saying that the weakening of the rays is proportional to the number of tubes stopped, and hence that the intensity is proportional to the number of tubes.

Röntgen Rays.—Zeit. f. Elek., April 1.—An abstract of a paper by De Heen. He calculates the velocity of the molecules radiating from the cathode and obtains a mean of 330,000 m; assuming that the velocity of the

molecules in the air at zero degrees is 485 m, then a velocity of 200,000 m would represent a temperature of 46,000,000 degrees; each molecule when striking a solid body will thus develop this extremely high temperature which will be transformed into ether rays of wave lengths which are smaller the higher the temperature; these ether rays are the X-rays; it is quite feasible to suppose that molecules at such a velocity could penetrate metallic plates like projectiles; according to this theory X-rays are ether vibrations produced by the impact of the cathode and anode streams on each other; the wave length, based on the temperature, he calculates to be at most 0.000.002 mm, while those of light are 0.000,764 and 0.000,387 mm. Recent researches of Winkelmann and Straubel are also abstracted briefly; among other things fluorspar is said to produce a transformation of the Röntgen rays into rays of other wave lengths, called fluorspar rays, which are capable of being refracted.

Application of Röntgen Rays for Measuring E. M. Fs. of Contact. PERRIN. *L'Ind. Elec.*, March 25, and *L'Eclairage Elec.*, March 27.—An abstract of an Academy paper. "Röntgen rays ionize the gases which they traverse, destroying in them the lines of force which they encounter;" for weak fields this property can be applied to the measurement of the E. M. Fs. of contact; such measurements are made with great ease.

Electrostatic Bending of Cathode Rays. JAUMANN. *L'Eclairage Elec.*, March 27; abstracted from the *Wied. Ann.*, 59, p. 252. According to Jaumann's theory the rays ought to follow the lines of electrostatic force; pending the verification of this theory he cites a number of observations which show the possibility.

Effect of Röntgen Rays on a Jet of Steam. RICHARZ. *Wied. Ann.*, 59, p 592; abstracted briefly in the *L'Eclairage Elec.*, March 27.—The rays can produce a condensation of steam which is shown by an experiment; the rays render the air conductive and affect its action on the condensation of dust.

Existence of Anode Rays. DE HEEN. *L'Eclairage Elec.*, March 27.—An abstract of an Academy paper. By connecting an insulated Crookes tube through spark gaps on both the positive and the negative sides, so that the cathode and the cross acted as the poles, he obtained a shadow when the former was the anode as when it was the cathode, though the shadows were somewhat different.

Experiments and Propositions of Jaumann. SWYNGEDAUW. *L'Eclairage Elec.*, March 27.—An article in which he discusses the propositions and proposed experiments of Jaumann concerning the diminution of the sparking distance by very small and very rapid potentials; the present author endeavors to show that the experiments of Jaumann belong under the heading of the effect of radiation on the spark gap; he shows that there are no experiments to prove that rapid variations of the potential of an exciter suffice for lowering the sparking potential.

Magnetic After-Action. KLEMENCIC. *Phil. Mag.*, April; abstracted briefly from the *Wiener Berichte*, March.—He uses the term magnetic after-action for the time retardation, denoted as creeping or viscous hysteresis; this occurs mostly in weak fields and diminishes with the strength of the field, the more rapidly the thinner the wire; no regular connection could be found between this action and the thickness of the wire; it is in no wise affected by strong magnetizations; it is a transitory phenomenon which is observed only in freshly annealed bars.

Röntgen Ray Burns. E. THOMSON. *Elec. Eng.*, April 14, and *West. Elec.*, April 17.—A short article in which he described investigations to find the cause of the injury to the skin, in view of the fact that a number of doubtful theories have been proposed. The effects are explained; the slight reddening lasts for a few days, fades away, but on the ninth day it increases again for a few days, followed by slow and tedious healing. A tube was constructed with the platinum reflector very close to the glass, so that a finger could be brought within half an inch of the source; the hand was shielded with a lead sheet having a hole in it, part of which was covered with heavy tinfoil and another with thin aluminum, thus making three spots, one of which was bare; the exposure was for 12 minutes; the part under the tinfoil was entirely unaffected while that covered by the aluminum was affected about as much as the bare spot, showing that this did not stop the rays; this proves that the effect is neither electrostatic nor ozonic but merely the result of certain rays reaching the skin, and they are probably the Röntgen rays which are not readily absorbed; according to the law of inverse squares this exposure corresponds to one of 50 hours at a distance of 10 inches; there need, therefore, be no occasion for alarm, as exposures of sufficient duration to do harm are rarely, if ever, necessary. He had previously shown that the injurious effects are also brought about when static machines instead of induction coils are used.

Röntgen and Lenard Rays. TESLA. *Elec. Eng.*, April 14.—A brief account of his address before the New York Academy of Sciences; it consists mainly of a mere mention of some of the topics about which he spoke. Regarding apparatus for generating high-frequency currents, which he considered the important element in the production of vacuum-tube lighting, he stated that it was only when he used the condenser that he succeeded in obtaining the desired action, but that it was now possible to secure millions of vibrations from ordinary circuits; a vacuum tube lit from a high-frequency machine was shown, as well as other experiments; a four-inch spark was obtained with an expenditure of energy equal to that required by one lamp; the apparatus can be connected to existing direct or alternating-current circuits. He discovered a new source of Röntgen rays which is far more powerful than the usual source, but there is great difficulty in maintaining it; it is an arc between a platinum terminal and an aluminum plate, inclosed in a glass jar; he also deflected the Röntgen rays by a magnet.

Röntgen-Ray Tube for Short Exposures. COLARDEAU. *Elec. Rev.*, April 14.—A short French Academy note from *Comptes Rendus*. After showing the disadvantages of the shape and dimensions of the usual tubes, he describes experiments to find where the cathode stream came most nearly to a point, and he noticed that it was often much beyond the centre of curvature, the distance varying with the vacuum; when placed at the centre of curvature the rays, therefore, do not meet at a point. He then constructed a cylindrical tube, not more than 6 or 7 mm in diameter; the radius of the curvature of the cathode was about 5 mm, its diameter being 4 mm, and the focus plate was placed at a distance of 7 to 8 mm; the tube was blown very thin where the rays passed out; such a tube must either be connected to a pump or to a vessel of large capacity; photographs of a child's hand were obtained with one discharge of a 25 to 30 cm spark, the duration being a thousandth of a second.

Transparency of Bodies to X-Rays. VAN AUBEL. *Elec. Rev.*, April 14.—A translation of the abstract noticed in the *Digest*, April 10.

Influence of Magnetic Field on Radiation Frequency. LODGE. *El'ty*, April 14.—A reprint of his short communication to the Royal Society regarding the discovery of Zeeman. (See *Digest*, March 6, 20 and 27.)

Magnetism for Engineers.—El'ty, April 14.—A reprint of the article noticed in the *Digest*, April 10.

ELECTRO-CHEMISTRY AND BATTERIES.

Ribbe Accumulator.—Lond. *Elec. Eng.*, April 9.—A brief illustrated description of a new form of battery which is now being introduced in England, and was invented by a German named Ribbe. It appears that the active material in thick masses is held to the supporting plate by sheets of perforated celluloid which are stretched and riveted or cemented through holes over the surface of the plate; the material can, therefore, not fall off. The Lond. *Elec. Rev.*, April 9, refers to it briefly in connection with a traction test, but questions whether it involves any improvement over batteries already well known and tried, and found wanting; lack of faith is expressed concerning the durability. (The compiler tried and abandoned practically the identical system eight years ago.)

Boese Accumulator.—Lond. *Elec. Rev.*, April 9.—A brief statement of some of the results of a test which was commenced in July of last year and is being continued, for testing the solidity of these batteries as much from a mechanical as from an electrical point of view.

Aluminum Process. MINET system. Lond. *Elec. Rev.*, April 9.—A very brief description, with some of the data, of this process which is in use at St. Michel, France.

Analysis for Ozone. TOMMASI. *L'Elec.*, March 25.—A note referring to the articles of Andreoli and describing a method for determining the percentage of ozone, even in the presence of other oxidizing products; it is based on the action of the arsenide of sodium.

Variation of the Dissociation Coefficient with Temperature. MILNER. *Phil. Mag.*, April.—A short article of a mathematical nature.

Relation of Electro Chemistry to Organic Chemistry. ELBS. *Elek. Anz.*, March 28.—The beginning of a reprint of a recent lecture.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Galvanometer Design. HOLMANN. *Phil. Mag.*, April.—A short note in reply to the one noticed in the *Digest*, Feb. 6; he acknowledges the error pointed out, but claims that it does not vitiate the inferences which were the main point of his paper, namely, the comparative inefficiency of the central portion of the coil and the consequent importance of employing exceedingly short needles.

Registering Ampere and Volt Meters. CHAUVIN and ARNOUX. *L'Ina. Elec.*, March 25.—An illustrated description of an instrument capable of registering from 1 to 5000 amperes; the galvanometer portion is quite similar to that in the Weston instrument and is used with different shunts; the registering portion consists of the usual form of revolving drum; a scale enables the deflection to be read off at all tmes.

Methods of Measurement. ARMAGNET. *L'Eclairage Elec.*, March 27.—A continuation of his long series on measuring instruments; he discusses errors and general methods.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telephone Cable. PIERARD. *L'Elec.*, April 3.—A criticism of the cable recently proposed by Preece in his British Association paper. He claims that there is considerable confusion in the description between mutual and self-induction, and that this confusion radically changes the conclusions; this he proceeds to show and finds that the capacity will be twice as great with respect to the earth as in the ordinary telegraphic cables, and nearly four times that of two wires used as a metallic circuit.

Railway Signals. Lond. *Elec. Rev.*, April 9.—A brief description of the

Siemens & Halske system in which every signal is fitted with a special continuous motor for operating the signal and reversing the points; the cost of this is not essentially higher than of a system with rods and wires; it has been in satisfactory use for some time.

Trunk Telephones. Gavey. Lond. *Elec. Rev.*, April 9.—A reply to Pierart's recent criticism (see *Digest*, Feb. 27); he thinks the explanation of the apparent discordance is obvious.

Cable Repairs. Benest. Lond. *Elec. Rev.*, April 9.—An abstract of a discussion of the paper noticed in the *Digest*, April 3.

Long-Distance Telephony. Therrell system. *Eng. News*, April 15.—A note stating that at a recent exhibition of this apparatus in Atlanta audible sounds were transmitted through resistances equal to 40,000 miles of ordinary telegraphic cable; the result is said to be obtained by having the original transmitter very powerful, and by using repeaters which "magnify the sound" at several stations along the line; for transatlantic telephony it is proposed to have repeaters in submarine chambers 1000 miles apart.

Fire Alarm Installation.—Jour. of El'ty, December.—A brief illustrated description of the installation of the system at Stockton, Cal., which is claimed to be one of the most modern installations of this class to be found in the country; the plant is entirely automatic in every detail; the switchboard, which is illustrated, is said to be one of the main features; storage batteries are used as a source of power.

Submarine Telegraphy. Mance. *Elec. Rev.*, April 14.—The beginning of a reprint in abstract of his recent inaugural address.

Telephone Rates.—Elec. Eng. and *Elec. Rev.*, April 14.—The argument of Bethell in the recent hearing at Albany.

MISCELLANEOUS.

Production of Yeast.—Elek. Anz., March 28.—A note stating that the cost of the production of yeast is very greatly reduced with the aid of electricity; after the diastase of the malt the latter is cooled to 15 or 18 degrees C. and subjected at the same time to a current of five amperes (the quantity of the material treated is not given); with this treatment all the bacteria from the air, as also the specific poisons in the yeast, are destroyed; the malt is then fermented by the addition of sterilized yeast, during which process, which is very rapid, the malt is also subjected to a current of suitable strength. No further information is given.

Personal.—Lond. *Elec. Rev.*, April 9.—An announcement of the death of Dr. Heinrich von Stephen, of the German Imperial Post Office. He was born in 1831; it was due to him that in 1875 the postal and telegraph systems of Germany were united; his most important work was the establishment of the Postal Union to which almost all civilized countries now adhere.

Personal.—Lond. *Elec. Rev.*, April 9.—A note stating that Mr. Preece has expressed his intention to retire from the General Post Office.

Conductivity of Cast Copper. Warren. *Eng. & Min. Jour.*, April 10.—A brief communication indorsing Channing's opinion (see *Digest*, April 10). Any one can make good cast copper if he will cast directly from the refinery furnace with such care as is ordinarily taken in the casting of wire bars; he made some recent tests with samples cut from regular wire bars, which showed that the conductivity was from 95 to 98 per cent. of that of the same copper rolled and drawn into wire and annealed, or about the same conductivity as hard drawn copper would have; cast copper is usually made at foundries where the proper smelting is not thoroughly understood. He was amused at a recent statement in which a composition containing 99.15 per cent. of copper was taken for purposes of comparison of conductivity; such copper is unfit, and should never be used for the manufacture of wire bars; pure "C. & H." Lake copper averages 99.88 per cent.

Smith Manifold Calculator. Low. *Jour. of El'ty*, December.—A continuation of the description of this calculator as applied to electrical formulas.

Lightning Rods. Heap. *Elec. Rev.*, April 14.—Brief instructions for erecting a good lightning conductor.

New Book.

ELECTRIC TELEGRAPHY. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. New York. The W. J. Johnston Company, 253 Broadway, 1897. 448 pages. Price, $1.00.

This is the tenth number of the Elementary Electro-Technical Series, and is written on the same general plan as the others. It differs from the work on the telephone in one point—that there is one chapter devoted to the history of the art. The subject of telegraphy is well covered; all of the ordinary systems, both land and submarine, are described; also the fac-simile and writing systems.

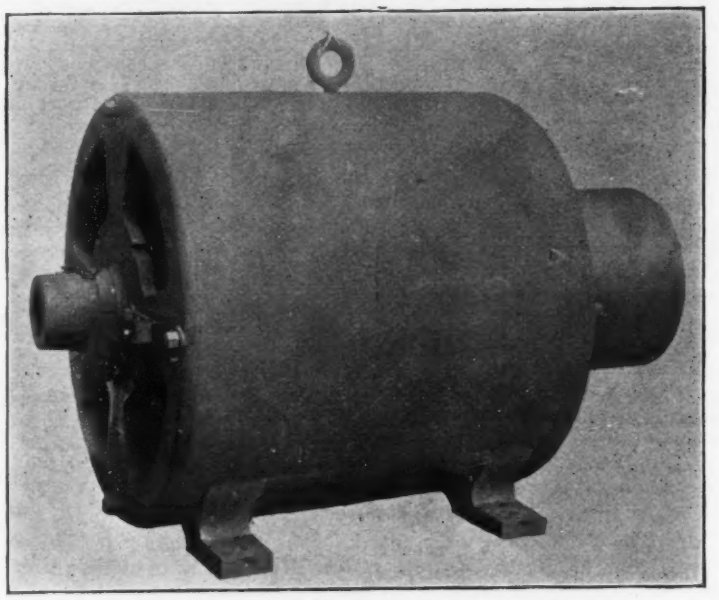
The duplex, quadruplex and multiplex methods are described and illustrated, giving to the beginner a very good idea of that, to him, mysterious process of sending several messages over the same wire simultaneously. Submarine telegraphy, on which subject Mr. Kennelly is a well-known authority, occupies two chapters. There is a map of the world, showing the cable connections and some of the overland connections. The methods of laying and repairing cables are very interesting and instructive, and require as much skill and knowledge as any operations connected with submarine telegraphy. These methods receive their due share of attention.

New Ironclad Motor.

The motor illustrated herewith is an example of the latest type of machine brought out by the C & C Electric Company, New York City.

The frame consists of a soft steel shell with radial poles projecting inward, the shell being capped at each end with a circular end plate, through which the bearings and rocker arm support are carried. The machine is of the four-pole type and the magnet coils may be readily removed after taking out the armature, the coils being interchangeable. The armature is of the drum type, having the conductors laid in slots, the coils being wound on forms. It is built up in a thoroughly substantial and scientific manner. The commutator is of generous proportions, with ample brush surface. Reaction type brush holders are used on this machine, which give a flexible and even pressure of the brush with minimum wear. The brush maintains a constant relative position on the commutator, thus avoiding the necessity of shifting the brushes forward when they have been shortened by wear. The shaft is of steel, rigid and of ample carrying capacity, and the bearings are self-oiling, provision being made for the supply of an abundance of clear oil.

The cylindrical form of the machine makes it well adapted for direct connection, either through gears or otherwise, and the machine itself can be placed in any horizontal position, thus making it well adapted to run as



Ironclad Motor of New Design.

a ceiling motor, or attached at any angle to an "A" frame, or it may be bolted to the bed-plate of any machine with which it may be combined. The magnetic field is compact, its circuits being of minimum length.

While improving on the ordinary type by providing an ironclad type of field, the outer shell also forms a protection to the motor, making it especially valuable where dust, dirt or dampness are apt to occur, and in fact, anywhere where employees are liable to be careless with reference to the motor.

On this motor, none of the moving parts, except the pulley, pinion or coupling, are outside of the shell, which arrangement secures safety not only to the operator, but also to the armature of the machine.

The motor is guaranteed to deliver the full rated horse-power in continuous service, at pulley, pinion or coupling, and it is claimed to have an efficiency of from 85 to 92 per cent., depending on the size of the motor. The company claims for this machine a wider range of application than any other motor on the market, as it can be belted, back-geared, direct-connected or furnished with change gears to drive at a range of speeds, and can be run in an inverted position or otherwise.

Some Mechanical Improvements in Armature Winding.

Among the modifications of the Eickemeyer method of winding drum armatures is that known as the barrel winding, which derives its name from its general resemblance to a barrel form. It consists in running the connectors outwardly from the end of the armature and keeping every part of the same at the same radial distance from the centre of the shaft, or nearly so. The arrangement is precisely that which would result if the conductors were arranged as in a developed winding diagram and the result wrapped in a cylindrical sheet around the core. The principle is illustrated diagrammatically in Fig. 1. This method of winding was in many respects inferior to the Eickemeyer principle and possessed certain disadvantageous features that became pronounced in practice.

Prof. Sidney H. Short, of Cleveland, Ohio, has succeeded, however, in improving the barrel method to a point where it may now be said to be a commercial success. The improvement consists in modifying the shape of the coil and in the adequate protection of the interior of the cylindrical extension formed by the end connectors. The effect of the improvements was to reduce the length of the armature to such an extent that it compared favorably with the closest Eickemeyer winding, and to correspondingly reduce the dead wire.

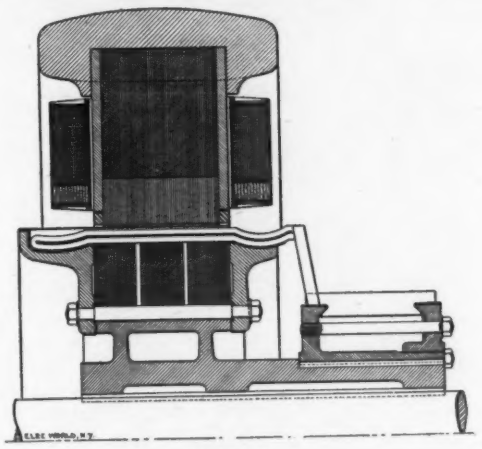


FIG. 1.

The nucleus of the improved coil is a strip of copper bent back on itself on the broad dimension, as shown in Fig. 2. The coil may then be bent to shape with a pair of pliers, as all of its sides are straight, resulting in the shape shown in Fig. 3; thus no special forming devices are necessary.

These straight coils lock together and form a projection from the end of

FIG. 2.

the armature with a shape somewhat suggestive of a druggist's mortar, as shown in Fig. 4.

The method of protecting the straight coil consists in simply extending the end discs to form a supporting and protecting flange, as shown in Fig. 4. This disc is of iron, and is therefore an oil, dirt and damage proof armor for the inside. The outside is much less exposed to damage and is

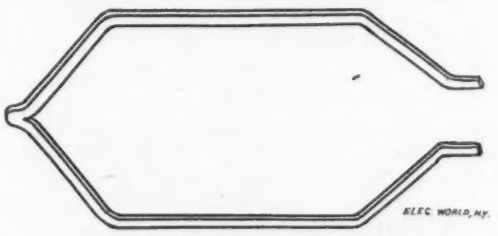


FIG. 3.

easily protected. The iron shield must of course be shaped to the peculiar curve in order to support the connectors throughout their length, but this is very easily done.

The combination is extended to both ends of the armature, excepting that on the commutator end the flange does not turn up on account of the connections to the commutator lugs. The depression in the extended surface formed by the end connectors is used to extremely good advantage,

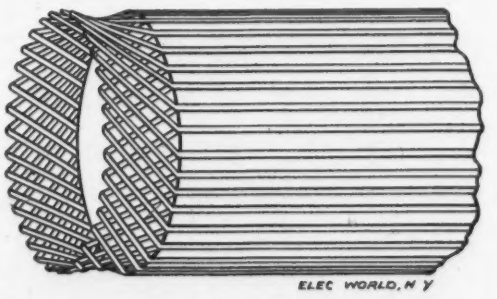


FIG. 4.

for it forms a pocket in which the band wires can be placed. Being supported from beneath, the coils can be strapped down to the shell with great force, which is not permissible with unsupported coils. Moreover, as the band wires are thus out of the magnetic field additional strength can be secured by sweating together, and there is no possible danger of overheating of the bands from eddy currents. Finally they are covered up by the canvas cover which protects the end connectors from dust and dirt.

This arrangement permits of the most complete insulation. The surface of the supporting shell is lined with fuller board and mica and the insulating troughs of the armature slots project outwardly over it, thus forming a lap joint and providing at this point a surface insulation between the taped coil and the core of the armature. On the commutator end the edge of the supporting flange is suitably shaped to carry a piece of insulation which bridges the short space between the end of the flange and the commutator lugs. This affords a more complete inclosure of the coils at this end.

Another feature of Mr. Short's winding is worthy of special mention. The ends of the coils are sweated into the commutator lugs in the usual way, but the latter are so proportioned that an excessive current will melt the joint apart and centrifugal force will open it. Thus, if the commutator is dirty and a coil becomes bridged it will not burn, but will, instead, be protected by this species of safety fuse.

By means of these improvements Mr. Short secures all of the numerous advantages of the barrel winding and eliminates its serious faults. Thus surrounded with safeguards it is almost impossible for accidents to occur.

Arc Light Cut-Outs.

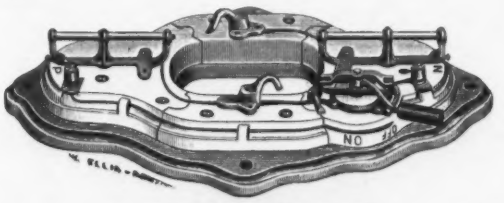
The Pettingell-Andrews Company, 72 and 74 Federal Street, Boston, Mass., has recently put on the market two styles of arc light cut-outs designed by the Boston Electric Light Company.

The "Senior" cut-out is especially adapted for use on buildings, on the

"SENIOR" ARC LIGHT CUT OUT. "JUNIOR" ARC LIGHT CUT OUT.

outside of stores, and, in fact, in any place exposed to the weather. The mechanism is contained in a glazed porcelain box which is absolutely waterproof. The device is designed to operate from 10 to 125 series arc lamps, and is furnished with a positive quick-break action, thereby preventing arcing at the contacts. It is operated by a hard rubber handle and all the parts are very highly insulated. An indicator, showing whether the switch is on or off, may be easily read through a small glazed aperture in the front.

The "Junior" cut-out is intended for use particularly in stores on circuits carrying from one to 12 arc lamps. The working parts are simple in construction and are also closed in a porcelain box. The position of the switch can be seen at a glance. Both styles can be furnished in black enamel if desired.



ARC LIGHT HANGER BOARD.

The Pettingell-Andrews Company also handles an arc light hanger board, which is built from plans furnished by the Boston Electric Light Company. It is designed to accommodate any size or style of arc lamp, thus providing a complete uniformity of construction in an interior arc light installation. The insulating parts are of heavy porcelain and the whole is mounted on a neatly finished wooden base. Each board is furnished with a switch indicating the on and off position.

Röntgen Ray Apparatus.

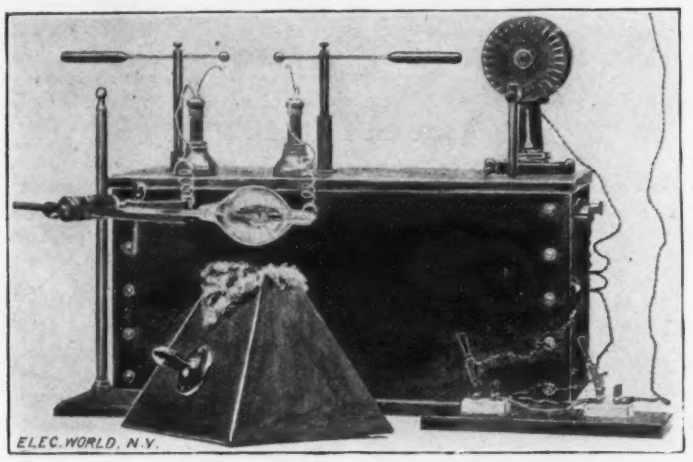
The deterioration of the best form of static machines, high-frequency coils and Crookes tubes has engaged the attention of the L. E. Knott Apparatus Company, Boston, Mass., ever since the announcement of Prof. Röntgen's discovery. Some of the results of its careful experimental work are briefly described below.

The static machine consists of four plates, the moving parts being mounted on highly polished bearings, and the whole inclosed in a moisture-proof case. It is arranged to be run either by hand or electric power. When

run by hand a speed of from 1800 to 2000 revolutions per minute can be obtained, giving so rapid a discharge that two lines of sparks may be observed. The company is prepared to furnish either a 110-volt direct-current motor having graphite bearings, or an induction motor with which to drive the machine. Both styles are very compact, can be readily placed within the case, and may be belted directly to the axle. In order to prevent the oxidization of the rubber plate a special preparation is spread over the surface.

The high-frequency coils are mounted in a substantial manner and present a very neat appearance. One style of coil is designed to be used on an alternating circuit and the other is for direct currents. The primary of the Tesla coil is made with a very low resistance, there being only a turn and a half of wire, thus cutting down the impedance and producing a very long spark in the secondary.

The Knott Apparatus Company has patented a new form of break wheel, which gives excellent service. A metal disc, having slots cut in the



Improved Röntgen Ray Apparatus.

periphery, is mounted between the electrodes of the gap and is driven by a small motor. The wheel produces a regular succession of breaks, which is very essential for fine work. The coil, when run from a 52-volt alternating current and taking a current of 3 1-2 amperes, will give a 10-inch discharge.

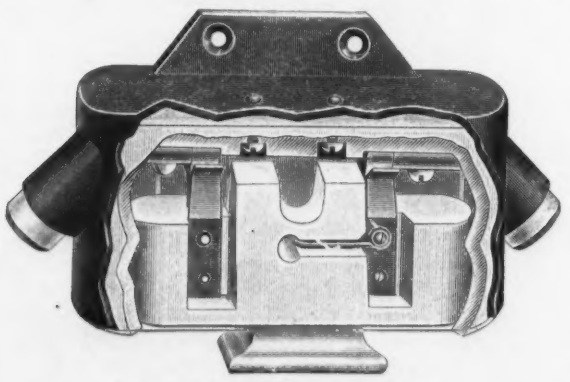
The direct-current coil is similar in design, but has in addition an interrupter driven by the same motor which runs the break wheel. This device gives two interruptions in one direction, a reversal and two interruptions in the other direction, following each other in rapid order. The final effect is an oscillating discharge similar to that produced by an alternating current. The motor is operated by a switch.

The Knott Company gives a great deal of attention to the manufacture of Röntgen-ray tubes. These are exhausted while the same kind of current is passing through them which is to be employed in operating them when in actual use, thus subjecting the electrodes to the same effects as in practice. Photographs taken with the tubes on both the static machines and high-frequency coils, it is stated, give very clear results, with an especially sharp definition. The company also handles fluoroscopes and a complete line of chemical and philosophical apparatus for experimental purposes.

Fuse Box.

The single pole primary fuse box illustrated herewith is offered by the Lakon Company, Elkhart, Ind., with the view to meeting a long-felt want.

It was originally designed for a transformer primary fuse box, but is

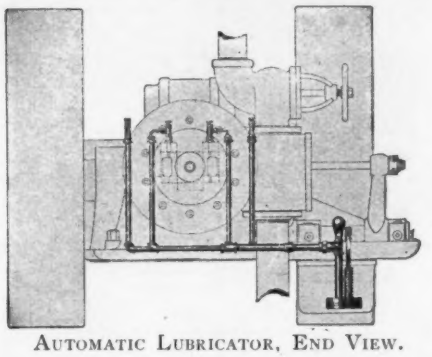


Single Pole Primary Fuse Box.

meeting with much success as a protection for taps from the main feeder circuit. Its principal advantage is that it is perfectly weather-proof, occupies but little space, is light in weight and easy to install, has ample contact surface, and the fuse in passing from one terminal to another makes two right angles through the solid block of porcelain, making arcing impossible. The box is a single casting, lined throughout with heavy porcelain, and is built to stand hard service.

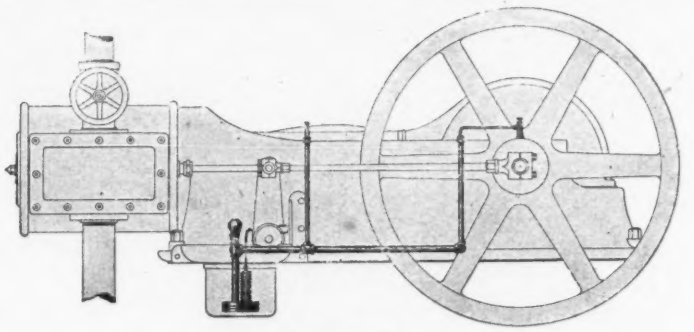
Automatic Lubrication.

The accompanying illustrations show the system of automatic lubrication which is applied to the American-Ball Engines, now being built at Bound Brook, N. J. The characteristic features of this system include a



Automatic Lubricator, End View.

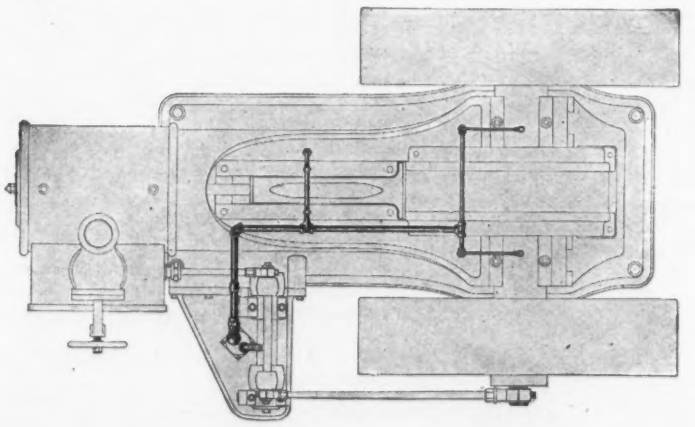
positive circulation of oil from an external storage tank into which the oil is strained on its return from the engine frame, and an entire separation of the water from the oil by means of a tight bulkhead near the cylinder end of the engine frame. The chamber thus formed collects the water dripped from the piston rod, and discharges it through a suitable



Side View.

drip pipe, while the steam escapes at the top of the chamber, which is open to the air.

A simple pump placed in the storage tank and actuated from the rock shaft circulates the oil through suitable pipes and discharge nozzles to the stationary working surfaces, whence it flows by gravity or centrifugal force to the crank pin and crosshead pins through oil holes and channels provided for that purpose, and thence by gravity back to the storage tank, on entering which it passes through a fine gauze strainer located in the tank.



Plan View.

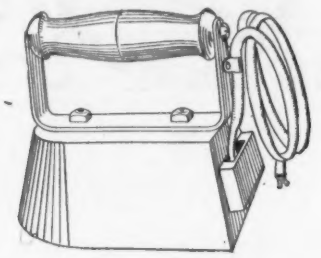
To insure an abundant supply of oil at the discharge nozzles, the pumping capacity is made to exceed the maximum requirement, and the surplus oil escaping through a relief valve falls back into the storage tank.

To provide against possible derangement of the pump, a gravity receptacle is arranged to be instantly attached to the system as an emergency supply.

A liberal supply of oil fed automatically to the working parts of an engine contributes to smooth, quiet running, and relieves the engineer from the drudgery of watching and refilling a lot of oil cups.

Hatter's Electric Iron.

The American Electric Heating Corporation, Boston, Mass., has added to its already large and varied line of electric heating utensils a novelty which will be appreciated by hatters. It consists of a hatter's iron with polished sides, and heated by electricity. It is made for all lighting voltages, and possesses the important advantages of cleanliness and quick heating, as compared with the older methods of heating.



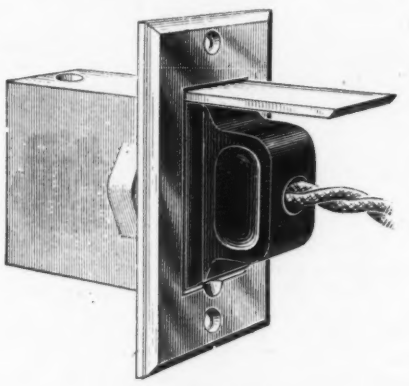
HATTER'S IRON.

This device is used in many of the large retail hat establishments throughout the country, as well as by manufacturers, and its many advantages should win for it much popularity.

An Improved Receptacle.

The accompanying illustration represents the Chapman receptacle, which was patented by Mr. F. A. Chapman, and is now manufactured exclusively by the Bryant Electric Company, Bridgeport, Conn.

This device has been on the market for a little more than a year, and the fact that it has been endorsed by the underwriters and adopted by many of the leading engineers for use in some of the finest office buildings in the country is ample recommendation to the trade. Up to the present time this receptacle has been made in one form only—that illustrated; but it is the intention of the Bryant Electric Company to place several different designs on the market in the near future and make a number of improvements.

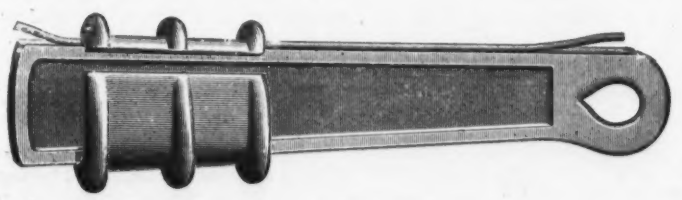


NEW RECEPTACLE.

A Novel Wire-Stretching Device.

Every electric line construction man will be interested in the device illustrated herewith, for which Messrs. J. H. Bunnell & Co., 76 Cortlandt Street, New York, are the sole agents.

It is called the "Cleveland Come-Along," or wire stretcher, and consists of only two pieces of malleable iron. It does away with all springs, screws, eccentrics, etc., yet is claimed to be the most positive in clamping and easiest to release of any clamp heretofore introduced. It is made in two sizes, the No. 1 for wires of a larger gauge than No. 8, and the No. 2 for No. 8 or smaller wires.



"CLEVELAND" COME-ALONG.

A wedge-shaped piece having an eye at its smaller end for attaching the rope, slides in a flattened tapering sleeve having a opening at one side to admit the wire. The edge of the wedge next the opening in the sleeve is grooved to fit the wire and is parallel to the adjacent wall of the sleeve, so that as the wedge is drawn towards the small end of the tapering sleeve the wire is clamped the whole length of the sleeve and held positively as long as the tension is maintained. On releasing the tension and giving the sleeve a slight blow at the small end the clamp is instantly released.

These Come-Alongs are made with copper faces for use with hard-drawn copper lines.

Some Specialties in Valves and Gauges.

We illustrate herewith various devices of a special nature manufactured by the Lunkenheimer Company, Cincinnati, Ohio.

The "Clip" double-seated gate valve (Fig. 1) has an iron body, is brass-mounted, and is designed for a working pressure of 100 pounds. In construction it is exceedingly simple. The valve will take pressure from either end, and not having any complicated interior mechanism it can be placed in any position. All the bearing parts of the valve are made of bronze, and the hub and body of iron. The several parts are well proportioned and heavy, and the valve is therefore free from the danger of the seats springing when connecting to pipes. The construction of the valve also permits of repacking the stuffing box while the valve is either open or closed. This valve is made in eight standard sizes.

In Fig. 2 is shown a sectional view of a regrinding swing check valve, which is of excellent material, design and workmanship. This valve is so designed that when the disk is raised the passage through the body is fully equal to the diameter of the connecting pipe. The valve is made of the best gun-metal composition, which insures greater durability. By means of the grinding feature the usefulness of the valve can be prolonged indefinitely. When worn in the seat the valve can be reground without removing the valve body from the connecting pipes. These check valves are made in eight different sizes, ranging from one-half inch to three inches.

Fig. 3 presents an illustration of the automatic water gauge, also manufactured by the Lunkenheimer Company. This gauge, it is stated, can be relied upon to act promptly in shutting off water from gauges when the glass breaks. When the valves are full open and the glass is filled with water, the pressure on both sides of the ball valves will be equal and they will remain off their seats, but should the glass break the sudden rush of water through the gauges causes the ball to close against the seats and thereby shut off the water and steam. This gauge is made of gun-metal composition, and carefully finished, and the company confidently recommends it to all steam users.

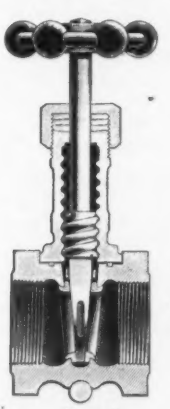


FIG. 1.

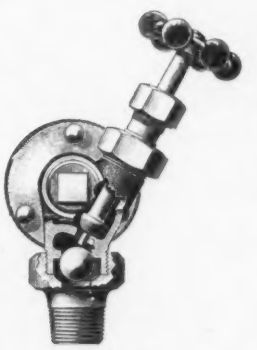


FIG. 3.

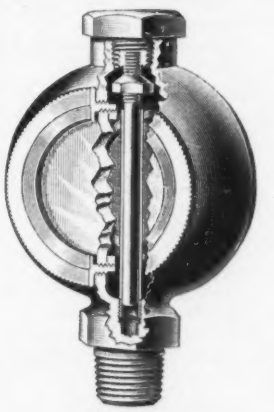


FIG. 4.

The "Champion" rod oil cup, manufactured by the Lunkenheimer Company, is shown in Fig. 4, which represents a sectional view of the interior construction of the cup. This cup is round in form, and on each side is a glass window to enable the engineer to ascertain the height of the oil. The feeding arrangement consists of tubes, one telescoping within the other, the outer tube being fastened permanently in the base of the cup and communicating with the oil hole in the shank of the same. The inner tube is fastened to the feeding cup, and has small oil holes drilled in it close to the top; it also carries a regulating nut on the upper portion, which nut is provided for the purpose of regulating the quantity of oil to be fed to the holes. This cup is suitable for all movable bearings, and the centrifugal force, combined with the shape of the body, carries the oil to the holes in the feed tube. It does not throw oil, and feeds only while the machinery is in operation. It is well made of cast brass, and is neat in appearance. It is made in four sizes.

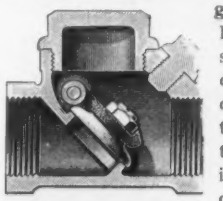


FIG. 2.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 19, 1897.

ELECTRICAL STOCKS.—No marked activity is indicated in this list of securities, the few recorded changes being slight. General Electric common receded ½ point. The sales of this stock during the past week were 6,645 shares, the highest point reached being 31½ and the lowest 30¾. Westinghouse is steady and New York Edison dropped 1½.

TELEGRAPH AND TELEPHONE.—Bell Telephone is 5 points higher than it was at the time of our last quotation, and New England Telephone advanced a fraction. Western Union Telegraph is weaker, and dropped a fraction of one point.

ELECTRIC TRACTIONS.—Street railway securities were very dull during the past week, little stock changing hands. Columbus Street Railway advanced 2 points on a limited trading. The company declared a quarterly dividend of 1 per cent., payable May 1. Buffalo Railway stock was fairly active at lower quotations, and the favorable report of the New Orleans Traction Company for March had little appreciable effect on the stock. The uncertainty on the question of municipal control of the Sixth and Eighth avenue lines in New York City had a depressing effect on these stocks.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	105	106½
Edison Electric Ill., Brooklyn	100	..	97
Edison Electric Ill., Boston	100	..	..
Edison Electric Ill., Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	20	20½
Electric Storage, pref	100	22	22½
General Electric	100	30½	30¾
General Electric, pref.	100	72	74
Westinghouse Consolidated, com	50	..	24
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	96	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	225	226
American District Telegraph	100	29	39
American Telegraph and Cable	100	87	88
Central and South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	64	64½
New England Telephone	100	..	102¼
Postal Telegraph Cable	100	96	98
Western Union Telegraph	100	80¼	80½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19¾	19⅞
Brooklyn Rapid Transit	..	20	21
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	71	73
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	43	45
Hestonville	100	49	50
Hestonville, pref	..	..	62½
New Orleans Tractjon	100	4	6
New Orleans Traction, pref	100	..	21
North Shore Traction	100	19	21
North Shore Traction, pref	100	75	79
Rochester Street Railway	..	..	11
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	71½	72
West End, Boston, pref	100	91¼	92
Worcester Traction	100	15	18
Worcester Traction, pref	100	91	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79½	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	104	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 20, 1897.

REMOVAL.—The Bi-Metallic Electric Transmission Company will on May 1 move to 121 Liberty Street from its present offices at 26 Cortlandt Street.

"THE ELECTRICAL ENGINEER" IN NEW OFFICES.—*The Electrical Engineer* has moved into new and larger quarters at No. 120 Liberty Street, New York.

J. G. WHITE & CO.—The firm of J. G. White & Co. has been organized under the New York laws to succeed to the business of the White-Crosby Company, 29 Broadway, New York City. The capital of J. G. White & Co. is $100,000, fully paid in.

MR. JOHN H. HOLMES, of the firm of J. H. Holmes & Co., electric light and power engineers, Newcastle-on-Tyne, England, is in the city making arrangements to build Lundell motors in England, and has about completed the negotiations. Mr. Holmes made a call at the office of THE ELECTRICAL WORLD last Monday.

OUT OF TOWN VISITORS.—The following named gentlemen registered at the headquarters of the National Electric Light Association, 136 Liberty Street, New York, during the week ending April 16: A. J. Simmons, Boston, Mass.; E. O. Waymire, Dayton, Ohio; N. J. Mitchell, Philadelphia, Pa., and F. M. Law, Philadelphia, Pa.

THE UNDERGROUND TROLLEY.—The New York & Harlem and the Metropolitan Street Railway companies have made application to the State Railroad Commission to use the underground system of electricity on several lines in New York City. The lines named are the Fourth Avenue line, and that on Astor Place between Fourth Avenue and Broadway.

EFFECT OF THE WAR ON CABLE BUSINESS.—The Commercial Cable Company announces that in consequence of the war between Greece and Turkey, messages destined for the latter country cannot be transmitted by the Trieste-Corfu cable, but only via Bosnia, Montenegro or Servia. The Turkish administration has decided not to admit private code or cipher messages for Turkey.

THE STANDARD UNDERGROUND CABLE COMPANY has moved its New York office from the Times Building to rooms 506, 508 and 510 Telephone Building, 18 Cortlandt Street. In its new quarters it has much more desirable and spacious apartments than in the old, and Mr. George L. Wiley, the New York manager, will be pleased to welcome his friends and customers at his new address.

THE NATIONAL CONDUIT & CABLE COMPANY.—The National Conduit Manufacturing Company and the National Underground Cable Company have been consolidated under the name of the National Conduit & Cable Company. The company's office is in the Times Building, and its officers are Edward S. Perot, president; C. Gallagher, vice-president; James P. McQuaide, treasurer, and George J. Jackson, secretary.

ELECTRICAL COURSE AT THE NEW YORK TRADE SCHOOL.—A very excellent course in practical electrical wiring and fitting is being conducted at the New York Trade School, First Avenue and Sixty-seventh Street, under the supervision of Mr. A. A. Hamerschlag. Instruction includes practice in actual wiring and the installation of electrical apparatus. The excellence of the teaching is indicated by various model wiring installations, which are executed in a masterly manner. Mr. Hamerschlag is also in charge of the St. George Trade School, where a similar course forms part of the instruction.

VENEZUELAN TELEGRAPH MONOPOLY.—The firm of Henry Clews & Co., made the announcement this week that the syndicate organized by that firm had secured from the Venezuelan Government a concession which gives it a complete monopoly of telegraph, cable and telephone lines in Venezuela. The concession is for thirty years, and the syndicate has to pay the Government of Venezuela $150,000 a year. The syndicate will take over the existing lines which are owned by the Government, and at the end of thirty years the lines will revert to the Government on payment by the latter to the syndicate of their appraised value.

JOHN SCOTT LEGACY PREMIUM AND MEDAL.—We have received a copy of the report of the committee on science and arts of the Franklin Institute, Philadelphia, under which the John Scott Legacy premium and medal were awarded to Messrs. Morris and Salom for their electrically-driven carriage. The report points out the following merits of the vehicle: Safety; freedom from vibration; freedom from heat and odor; simplicity of construction; ease of handling and perfection of control, and advantages of storage battery power. It considers the invention worthy of high commendation, and recommends the award of the premium and medal to the inventors, Pedro G. Salom and Henry G. Morris. The Electric Carriage & Wagon Company is now operating a number of these carriages in New York City.

ELECTRIC ELEVATORS IN NEW BUILDINGS.—The flexibility of the electric elevator machine has recently been most strikingly illustrated at one of New York's newest sky-scrapers, now being erected in the lower part of the city. Three electric elevators were installed and put in operation while the building was in the very early stages of construction. They were supplied with street service electric current and operated rough cages, serving as a hoist for building material, and for the various mechanics. Not only has a great deal of time been saved by the early installation of the elevator apparatus, but so efficient has the freight service been that the hod carriers' work has been largely dispensed with resulting in a saving of money, and at the same time bringing forth a strong objection from the Hod Carriers' Union.

DINNER OF THE ELECTRICAL CONTRACTORS' ASSOCIATION.—The fifth annual dinner of the Electrical Contractors' Association was held at Hotel Flouret, corner of Fifth Avenue and 18th Street, New York, on the evening of April 21, and was unquestionably one of the most elaborate functions of the kind ever given in New York City by a body of electrical men. Over the main entrance to the hotel the letters "E. C. A." in brilliant electric bulbs arrested the attention, and at the door stood Mr. J. P. Hall of the Reception Committee, who welcomed the members and guests. The dining hall was artistically and profusely decorated with the American colors, and banners with the stars and stripes hung on the walls. It was about 8 o'clock when the gathering, to the number of nearly 100, took their seats at the table, at the head of which sat Mr. J. C. Hatzel, president of the association, and Mr. John T. Hunt, toastmaster. The menu was happily conceived, and as it was a unique production of its kind, we reproduce it herewith:

SPECIFICATION
OF
MENU.

Cocktail or Sherry, (Infinite.)
Blue Point Oysters, (Key Receptacles,)
Celery, Radishes, Olives,
Lyon Sausage, Salted Almonds.
Sauternes, (100,000 ohms.)

SOUPS.

Petite Marmite, Bisque of Lobster, Victoria (In outlet boxes)

FISH.

Braised Bass a la Barsac, (Without fish wire.)
Boiled Potatoes, Parisienne, (Without C. J.)
Pontet-Canet, (10,000 ohms.)

RELEVE.

Patties, Egyptienne, (P. B'd.)

ENTREE.

Beef Tenderloin, Bouquetiere, (Heavy insulation.)

VEGETABLES.

Asparagus, Sauce Hollandaise, (Iron armored,)
Spaghetti a la Sicilienne, (White core.)
Moet & Chandon, W. Seal, (+ ground.)

ROAST.

Quail on toast, (a la Fire Dep't). Salad, (With fixture bugs.)
Liquors, (— ground.)

DESSERT.

Pineapple a la d'Orleans (40° Centigrade.) Fancy Ice Cream.
Assorted Cakes. Cheese. Fruits.
Ambrosia Coffee, (No grounds.)
Cigars, (Short circuit.)

MUSIC.

THE ARCHITECTS RESERVE THE RIGHT TO REJECT ANY OR ALL BIDS

After the "grounds" and "short circuits" had been removed the party listened with much interest to the remarks made by several well-known gentlemen in response to toasts, as follows: "The Electrical Contractors' Association," by Mr. J. C. Hatzel; "Our Guests," by Mr. E. H. Johnson; "The Fire Department," by Mr. Alexander Henderson; "New York Board of Fire Underwriters," by Mr. W. A. Anderson; "The Illuminating Companies," by J. W. Lieb, Jr.; "The Electrical Engineers," by Mr. C. O. Mailloux; "The Technical Press," by Mr. T. C. Martin; "Our Creditors," by Mr. James W. Godfrey. After the toasts the company was entertained by several well-known artists, who rendered some instrumental and vocal music with fine effect, and gave several excellent recitations. A magician performed several very clever tricks, and after the singing of "Auld Lang Syne" the party dispersed. The programme of the evening was very handsomely gotten up. The cover was of satin-silk, with a very artistically wrought design on the front, symbolical of the development of the electric light.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., April 20, 1897.

THE GLOBE NICKEL PLATING COMPANY has just opened up for business at 15 Chardon Street, Boston. Mr. Henry R. Downes and Mr. C. H. Barnard comprise the management. Both of these gentlemen were for many years connected with the Boston Nickel Plating Company; consequently they are very well known to the trade, and will undoubtedly command success.

THE WASHBURN & MOEN MANUFACTURING COMPANY, Worcester, Mass., has just opened a Boston office at Nos. 166 and 168 High Street, which will undoubtedly be good news to and greatly appreciated by its numerous customers who come to Boston more frequently than Worcester, to say nothing of the fact that the Boston office is in position to supply quickly from the stock carried in it. The Boston office is centrally located, and occupies two floors, embracing about 2,000 feet, in which is carried a well-distributed stock of insulated and bare wire, wire rope and barbed wire. This office is in charge of Mr. Wm. A. Atwater, who is in every way competent by experience to represent the Washburn & Moen Company creditably and profitably.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., April 19, 1897.

EXTENSIONS OF BUFFALO RAILWAYS.—The president of the Buffalo Traction Company has signed certificates of consent for the construction of 15 miles of road in this city immediately.

MR. E. G. ACHESON, president of the Carborundum Company, Niagara Falls, has sailed for Germany to establish a plant there for the manufacture of carborundum under the German patents of the company. He is accompanied by Mr. James Hipple, who spent several years abroad as representative of Mr. Thomas A. Edison.

NEW ROAD INCORPORATED.—A certificate of incorporation has been granted the Buffalo, Hamburg & Armor Railway Company. During the coming summer it will endeavor to complete a line connecting Hamburg with Armor, Orchard Park, East Aurora and Buffalo. The head office of the company will be located in Hamburg.

NIAGARA POWER WHEEL PIT.—Nearly all the masons who were working on the wheel-pit extension have been laid off, owing to a lack of material. Many of the huge blocks of stone left near the top of the pit all winter have been badly cracked by the frost and are unfit for use. New stone must be obtained. The wheel pit is now to a depth of 129 feet. The average rate at which it is being excavated is from 12 to 15 feet a month.

THE LOCKPORT GAS & ELECTRIC LIGHT COMPANY has been beaten in its struggle with the city. It has at last reduced its bid to the old prize of $72 per lamp per year. Last winter the company refused to renew the contract for lighting the streets of Lockport for less than $90 per light per annum. The citizens did not wish to pay this and every effort was made to avoid doing so. A municipal lighting bill was introduced at Albany, but it slept in the arms of Senator Ellsworth, who owns stock in the electric company. The Common Council then passed a resolution to light the city with kerosene lamps, but this was vetoed by the Mayor, as was also another resolution to accept a bid made by the Welsbach Street Lighting Company. In the meantime, on April 1 the contracts with the electric lighting company expired, and the current was turned off, leaving Lockport in darkness. Still the city did not give in. On the evening of April 12 the company entered its old bid of $72, which the Council promptly accepted.

A NEW ELECTRIC ROAD.—The Buffalo, Niagara River & Grand Island Railway Company has been incorporated with a capital stock of $30,000, to operate a street surface electric road from Buffalo to the dock of the Buffalo & Grand Island Ferry on the Niagara River, in the town of Tonawanda. The directors are: Donoto A. Crage, Wm. E. Tench, Geo. A. Ricker, J. M. Metcalf, Herbert P. Bissell and others. The route of the proposed railway is from the corner of Tonawanda and O'Neil Streets, through Tonawanda Street and the River road to the ferry dock, a distance of one mile and a quarter. The tracks of the Buffalo Railway Company, the Buffalo Traction Company and Smith's electric road all come together at Tonawanda and O'Neil Streets, and the new line to the dock will enable persons bound for Grand Island to reach the ferry by way of these lines. At present there are no street railway connections to the ferry dock. The projector of the road is Wm. E. Tench, of the firm of Crage & Tench, of this city, the builders of the Gorge road.

PITTSBURG NOTES.

PITTSBURG, Pa., April 17, 1897.

THE STANDARD UNDERGROUND CABLE COMPANY has declared its regular quarterly dividend of 2 per cent.

MR. H. M. DOUBLEDAY, formerly president of the Electrical Supply & Construction Company, has organized the Doubleday Electric Company, and has opened a general electrical supply business at 609 Smithfield Street, the premises now occupied by the Electrical Supply & Construction Company.

SHERIFF'S SALE.—On April 20 the property of the Electrical Supply & Construction Company, consisting of motors, a stock of electrical supplies, and the leasehold of the premises at 609 Smithfield Street, was sold at auction by the sheriff on executions issued by The E. S. Greeley & Co., New York, the First National Bank, Pittsburg, and Cora B. Childs.

NEW STREET RAILWAY COMPANY CHARTERED.—A charter was granted at Harrisburg on April 15 to the Beechwood Street Railway Company, organized for the purpose of building in Pittsburg a road two and one-half miles long. The route described is in the Squirrel Hill district, along Forbes Street and Shady Avenue, and shows that the supposed road will connect with the tracks of the Consolidated Traction Company at the corner of Forbes and Craig Streets. The president of the company is Peter Shields, and the other directors are Frank McCann, D. R. Deely, Charles Donnelly and J. F. Steel all of Pittsburg. The capital stock is $15,000.

THE HOMESTEAD & HIGHLANDS STREET RAILWAY COMPANY has let the contract for a portion of its proposed extension to Mc-

Keesport. The work arranged for covers a distance of about one mile, between Munhall, the present terminus of the road, and Harden station. The work is to be completed by June 1 next. It is reported that an arrangement has been made with the Consolidated Traction Company for running the Homestead and Highlands cars over its tracks from Boquet Street into the heart of the city, so that cars may be run through from Braddock and Homestead into the city without transferring passengers.

Cleveland Notes.

Cleveland, Ohio, April 19. 1897.

NEW SURVEY.—Surveyors began work yesterday on the proposed electric line to run through the south part of Lorain County. The commissioners have granted a franchise for the road, which passes through Carlisle, LaGrange and Pennfield, and will connect in Elyria with a Cleveland line.

THROUGH CARS.—The people of Elyria, Ohio, are much pleased by the cars of the Cleveland, Berea & Eastern Railroad having started last Thursday running through to the Public Square, Cleveland. Up to that date this company's cars ran only to the city limits, where passengers had to transfer to the cars of the Cleveland line.

FIFTY YEAR FRANCHISES.—In spite of statements to the contrary made by railroad officials, it is a well-known fact that within three weeks an effort will be made by the Cleveland street railway companies to secure fifty-year franchises from the city council. It is claimed that the success in getting the Burton Street franchise has stimulated the companies to make a strong effort to secure the long franchises.

CITY ORDINANCE GRANTED.—After a hard fight in the city council last Monday night an ordinance was granted the Cleveland Electric Railway Company to extend its tracks along Burton Street. The ordinance was passed over the mayor's veto by a vote of fifteen to seven. Mayor McKisson was strongly opposed to granting what he claimed will be a valuable franchise without getting something in return for the city.

INCREASE IN EARNINGS.—The Cleveland suburban street railway lines show a remarkably big increase in their earnings for March. That month is not generally considered a good month for travel, and yet the gross passenger earnings of the Akron, Bedford & Cleveland were $778 more than the month previous, and $815 more than March last year. The Cleveland, Painesville & Eastern also made a good showing. The gross passenger earnings for March were $5,483, against $4,526, an increase of $957. The earnings of both these lines will be greater when the expressage, etc., is added.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., April 17, 1897.

MR. H. J. MEDBERY, president of the Fiberite Company, Mechanicville, N. Y., and Mr. H. B. Coho, of the firm of H. B. Coho & Co., New York City, were welcome visitors at the Chicago office of The Electrical World last week.

THE STROMBERG & CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, has installed a very handsome switchboard at Michigan City, Ind. Under the superintendence of General Manager Ross this company is making rapid strides in the telephone business.

THE H. M. UNDERWOOD COMPANY, Marquette Building, Chicago, is doing a business far beyond its expectation with its lamp guard. This is a device that ought to be used by all central stations and isolated plants, being considered one of the most complete lamp guards on the market.

LIGHT FOR THE FAIR BUILDING.—The contract for 150-hour lamps for the new Fair Building in Chicago, has been awarded to the Western Electric Company. About 350 lamps will be necessary. Ten different manufacturers submitted samples of their lamps, which were burned for six weeks side by side, all of which were tested by experts from the Armour Institute, Chicago, also by the electrical department of the Fair. The awarding of the contract to the Western Electric Company is an excellent testimonial for its lamps. These lamps give a very white light, free from shadows, which is a very great advantage, especially in matching colors.

Milwaukee Notes.

Milwaukee, Wis., April 19, 1897.

THE GIBBS ELECTRIC COMPANY, manufacturer of the Gibbs dynamos and motors, reports that the demand for its machines is making things busy, and that orders are daily arriving from all parts of the country.

MR. JACOB CLOOS has opened an office in the Pabst Building, and will give his attention to consulting engineering. Mr. Cloos resigned as mechanical and electrical engineer for the Pabst Heat, Light & Power plant to go into business for himself, and has met with the best of success.

THE PABST BREWING COMPANY is remodeling its building, corner West Water and Grand avenue. Mr. Jacob Cloos has been engaged as consulting engineer. It is understood that a complete and modern electric light plant will be installed. The contract for the wiring has been awarded to Rohn & Meyer, who will install the iron conduit system. Specifications for the electrical machinery have not yet been drawn up.

THE EVENING WISCONSIN PUBLISHING COMPANY is enlarging its electric light and power plant. Messrs. Kellyn & Smith have just finished setting up in the building a 45-kw Wenstrom dynamo belt connected. This machine replaces a 400-light American dynamo, and will furnish current for all the lights in the building and four motors, ranging from 1 to 20 hp; also a motor for a Smith-Hill electric elevator. A 600-light American direct connected unit has been ordered, and as soon as it arrives the load will be divided between it and the Wenstrom machine.

St. Louis Notes.

St. Louis, Mo., April 19, 1897.

CONTRACT AWARDED.—Bagnell & McDonald, of this city, have been awarded the contracts for the construction of the conduits for the Bell Telephone Company. The work began this morning. Seventy miles of conduits will be laid to carry 100 miles of ducts.

TROUBLE WITH HIGH TENSION COMPANIES.—The Board of Public Improvements is having some trouble with the high tension companies in the matter of conduits. A long time ago it notified the qualified applicants for space in Broadway that they could begin work on a joint conduit as soon as they had agreed about apportioning the expense. It seems that they cannot reach any agreement, and the matter of apportionment will fall on the board.

EDISON REORGANIZATION.—The reorganization committee of the Edison Illuminating Company will meet early this week, and set a day for the sale at public vendue of the property of the company, which consists of the plants and the poles and the wires strung all over town. The committee has received all the bonds with the exception of three, which cannot be located. All the stock has been turned in except 1,166½ shares. To 400 shares of this the committee has a clew.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, Mo., states that Mr. I. J. Kusel, president of that company, has disposed of his interests in the concern, has resigned his position and is no longer connected with the company. Mr. J. D. Perry Lewis has been elected president of the company. He is an experienced electrician and thoroughly competent to fill the office. The business under the new management will be conducted along the same lines as heretofore.

CITY LIGHTING.—According to the annual report of Supervisor O'Reilly, of the Lighting Department, the streets, alleys and public places of St. Louis were lighted on the first day of April with 3,903 incandescent lamps and 2,312 arc lamps. On that day the public buildings and institutions of the city used 5,436 incandescent and 73 arc lamps. The companies doing the city lighting have all along been in arrears. Under their contract lamps must be in position within thirty days after the order is given. On Apri 1, 248 arc lamps, ordered on or before March 1, had not yet been placed in service. Last year's appropriation for public lighting amounted to $382,400. The total expenditure during the year was $336,078.55, leaving a balance of $46,321.45 to be returned to the general fund. Electric lights used in the streets and alleys during the year cost $214,892.92, and the lighting of public buildings, $55,954.05.

Pacific Coast Notes.

San Francisco, Cal., April 13, 1896.

TO CHANGE TO ELECTRIC POWER.—It is reported that the Redondo Railway, Los Angeles, Cal., will soon be changed over to an electric line and extended to San Pedro.

THE PASADENA & MOUNT LOWE RAILROAD COMPANY has filed articles of incorporation with a capitalization of $600,000, by Henry M. Newby, A. B. Cody, J. S. Torrence, J. D. Pope, Andrew McNally and P. M. Green. As soon as the company now owning the Mount Lowe Railway has its property sold under foreclosure, the new company hopes to obtain control.

AFTER WATER POWER.—John Ryland, of San Jose, Cal., and other capitalists have sent a party of engineers into the mountains to attempt to obtain water power by artificially combining streams or otherwise. R. Leo Van der Naillen, of San Francisco, is in charge of the expedition. The idea is to establish an electric transmission system to supply San Jose, and possibly Los Gatos.

LARGE ELECTRIC PLANT IN SUGAR FACTORY.—It is reported that a central-station plant having a capacity of 1,200 horse-power will be installed to supply electricity for various purposes at the new Spreckels beet sugar factory near Salinas City, Cal. Chas. C. Moore & Co., San Francisco, recently sold 48 Babcock & Wilcox sectional boilers, aggregating 9,000 horse-power in capacity, which will be used in the new manufactory. W. C. Waters is the engineer for the Spreckels sugar plant.

BIDS WANTED.—The city of Astoria, Oregon, has arranged to have arc lights operated from the plant owned by the West Shore Mills at $17 a lamp until the new municipal electric plant is completed. Sealed proposals will be received until May 1 for the installation of a water-power arc light plant, to be operated by an impulse wheel, and to have a capacity of 60 series arc lights. The Water Commission will receive the bids. Arthur L. Adams, C. E., 401 California Street, San Francisco, is engineer for the commission.

ELECTRICITY ON THE SOUTHERN PACIFIC ROAD.—Leading newspapers claim that the Southern Pacific Railroad Company is very desirous of building and operating an electric railway to San Jose from San Francisco, a distance of 50 miles. Also, that the company has been quietly getting its right of way widened for the purpose, where necessary. The president of the Southern Pacific will not admit that an immediate move in that direction is contemplated, but says it is among the possibilities when construction work on another line in Southern California is completed. The projected electric line would relieve the pressure from suburban trains on the single-track main line, and give San Jose an increased service.

Canadian Notes.

Ottawa, Ont., April 19, 1897.

MR. J. E. HUTCHESON, of the Ottawa Electric Railway Company, has gone to New York to secure attractions for the opening of the Victoria Electric Park, about three miles from the city, which will take place on the 24th of May next.

NEW ROAD TO BE BUILT.—The Hamilton Radial Electric Railway di-

rectors, Hamilton, Ont., have secured the right of way through Burlington. It is the intention of the company to continue the road only to Port Nelson. The Oakville extension will not be proceeded with before next fall.

TO INCREASE ITS STOCK.—In view of reimbursing amounts already expended and also of providing for further expenditure in connection with the extension of the company's lines and increase of its rolling stock, power, plant, etc., the Montreal Street Railway directorate has been authorized to issue new stock to the extent of $1,000,000. Each shareholder is given the option of purchasing at par, or $50, one of the new shares for every four of the old held by him. Once the news became public, large blocks changed hands and prices advanced to 235. The directors were complimented upon their splendid management of the affairs of the company.

A PROJECTED ROAD.—Mr. Albert J. Corriveau left Montreal yesterday for New York, where he will meet a number of capitalists who are interested with Canadian gentlemen in a big electric railway scheme. A plan is mooted to build an electric railway from St. Lambert or Longueuil, opposite Montreal, to points in Eastern Quebec not touched by the trunk line railways, as far as Sherbrooke, with crossing powers over the bridges and ultimately connecting with the railway systems at Newport, Vt. The company also proposes to put electric launches on the River Richelieu to run from St. Johns, Quebec Province, to points on Lake Champlain. The whole system will cover something like 150 miles, and the power is to be supplied by the Chambly Rapids Water & Power Company, which also expects to deliver 100,000 horse-power in Montreal by the middle of July next.

ENGLISH NOTES.

From Our Own Correspondent.)

LONDON, April 7, 1897.

MUNICIPAL PURCHASE OF ELECTRIC LIGHTING CONCERNS.—Following the example of Liverpool, Southampton and other towns, the corporation of Sheffield proposes to purchase the prosperous concern known as the Sheffield Electric Light & Power Company, which has recently declared a dividend of 7 per cent. The municipality is to hand over to the shareholders in the company municipal stock sufficient to pay 5 per cent. interest on the total sum the company has expended in plants and mains.

MUNICIPAL TELEPHONY.—Glasgow, which has for several years past been pertinacious in pressing upon the Post Office its demand to manage its own telephone service, would seem at last to have got the Postmaster General into a corner. A deputation waited upon him last week, and the Postmaster had to promise not only to carefully consider the matter, which, of course, every official is ready to do, but had to promise to give a definite answer as soon as possible. It is difficult to see how the Post Office can avoid acceding to the request of the Glasgow municipality, seeing that when it obtained Parliamentary sanction for the purchase of the telephone trunk wires of the country, and entered into a more or less close alliance with the National Telephone Company, it obtained this sanction upon the distinct promise that wherever the urban service of the National Company gave dissatisfaction it would not hesitate to grant licenses to municipalities or other substantial bodies.

TELEPHONE TRUNK LINES.—In the just issued fifteenth annual report of the Council of the London Chamber of Commerce reference is made to the numerous complaints arising both from London and the large provincial towns with regard to the delays which occur in the matter of telephonic trunk communication since the management of the telephone trunk wires has been taken over by the Post Office and consequently thrown open to the public. Many explanations have been offered by the Post Office with regard to this delay, the most common up till recently being that the two staffs were not properly exercised in joint working. According to the reference in this report, however, it would seem that the latest explanation is that owing to the trunk wires being thrown open to the public, the number of trunk telephone communications has been so great that it has extended beyond the carrying power of the existing lines, although the mileage of these was largely increased by the Post Office before it began to take over the system. The commercial community of this country will therefore have to wait for redress until the Post Office has found time and money to bring up the mileage of the telephone trunk system of this country to the figure necessary to meet the existing traffic.

A NEW AND INTERESTING USE FOR RÖNTGEN RAYS. At the Royal Institution last week Mr. Heycock delivered an interesting discourse, entitled, "Metallic Alloys in the Theory of Solution." Throughout his lecture Mr. Heycock drew analogies between aqueous solutions of salts and solutions of metals in metals, and he concluded his interesting discourse with a description of an experiment of exceptional interest. He first explained that when a salt such as potassium permanganate is dissolved in water and then slowly frozen the salt separates itself out from the ice and forms a core in the centre of the vessel. He then drew attention to the fact that the composition of metallic alloys is still a vexed question, and stated that he and a colleague had lighted upon a method which they hoped would prove of some use in solving the question of the true physical constitution of metallic mixtures, since some metals, such as sodium, permit of the passage through them of Röntgen rays, others, such as gold, are comparatively opaque.. Mr. Heycock and Mr. Griffifths made an alloy of sodium and gold, containing a very small percentage of the latter metal, and allowed it to cool very slowly just as the solution of potassium permanganate had cooled in water. When cold a very thin section was cut and then radiographed. This radiograph revealed the fact that the sodium had crystallized out from the general mass. This is one of the most interesting results which has yet been brought about by means of the Röntgen rays, and it opens up a large field in microscopic photography, and it will no doubt considerably enlighten us with regard to the true nature of alloys.

General News.

NEW INCORPORATIONS.

THE GOODRICH FALLS ELECTRIC COMPANY, Concord, N. H., has filed articles of incorporation with the Secretary of State. Capital stock, $30,000.

THE GALVESTON & HOUSTON ELECTRIC RAILWAY COMPANY, Galveston, Texas, has been incorporated by A. B. Blevin and William Brandburn, with a capital stock of $150,000.

THE MARKS ENCLOSED ARC LIGHT COMPANY, of New York City, has been incorporated by Marcus W. Marks, Fred W. Marks and Louis B. Marks, of New York City. Capital stock, $10,000.

THE FRIES MANUFACTURING & POWER COMPANY, Statesville, N. C., has been organized with a capital stock of $60,000, for the purpose of establishing an electric light plant on the Yadkin River.

THE KENONA & PRATTSBURG RAILWAY COMPANY, South Bethlehem, Pa., has been incorporated with a capital stock of $120,000. The directors of the company are Lewis Randolph, J. L. Suydam and William Carpenter.

THE AURORA, YORKVILLE & MORRIS RAILWAY COMPANY, Aurora, Ill., has been formed for the purpose of constructing and operating street and other railways in Kane, Kendall and Grundy Counties. Those interested are Vine A. Watkins, H. P. Horde and Fayette D. Winslow. Capital stock, $10,000.

THE CHASE CONSTRUCTION COMPANY of Detroit, Mich., has just been incorporated with an authorized capital of $25,000. The company will devote itself to the construction and equipment of central station lighting, electric railway, steam and water works plants. The company has just secured a contract to construct an electric railway running between Cleveland and Lorain, Ohio, for the Lorain & Cleveland Electric Railroad Company, the road to be completed by June 1, next. The officers of the new company are George E. Fisher, president and treasurer; O. D. Chase, secretary and chief engineer, and E. N. Chase, vice-president and superintendent of construction.

THE MELLEN WATER & LIGHTING COMPANY has been organized in Mellen, Wis., with a capital stock of $5,000. The incorporators are J. F. Reibenor, G. A. Hennell and H. E. Willoughby. The company intends to utilize the water of the Bad River, which runs through the city, and has a head of 50 feet, and will furnish the city with water and electric lights. It intends to build a dam about half a mile south of this place and will run a 3-foot water pipe to a point within the city limits, where the water works and central station will be located. Two turbines will be put in, one to drive the generator and the other to furnish power for the pumps. Mr. Henry Rettinghouse, of Ashland, Wis., has completed the plans and specifications for the plant and work will be commenced at once. The company will also furnish power for various industrial establishments already located here.

THE TELEGRAPH AND TELEPHONE.

CLINTON, MO.—The Anti-Bell Telephone Company has established an office in this city. It gives connection with various places in this part of the State.

LOWELL, MASS.—The Erie Telegraph & Telephone Company made a net gain of 432 subscribers in March, and 795 since January 1. Total number connected April 1, 22,184.

ANDERSON, IND.—The City Council has granted a franchise to the Holbrook Telephone Company, of Indianapolis, and a telephone war will be likely precipitated by this action.

DIXON, ILL.—Both the Lee County and the Central Union Telephone companies have been granted franchises to erect poles, string wires and do a general telephone business in this town.

MACOMB CITY, MISS.—Messrs. William White and J. W. Johnson are taking steps toward establishing a telephone exchange in this place. All the nearby towns will be connected in one system.

MT. MORRIS, ILL.—It is stated that the Rockford and Dixon telephone line will be built during the summer, and that Mt. Morris, Forreston and Polo will be put in direct connection with the long-distance system.

MILWAUKEE, WIS.—The telephone toll line of the Dane County Telephone Company is to be extended to the villages of Middleton, Verona, Paoli and Belleville. The contract has been let and work will be started at once.

NEWARK, N. J.—Application has been made for a receiver for the Newark Telephone Company by Mr. Frank H. Hall, of Jersey City. Mr. Hall, it is stated, charges that the company is insolvent and that its business is being conducted at a loss.

BURLINGTON, IOWA.—It is reported that the Iowa Telephone Company has mortgaged all its property to the Illinois Trust and Savings Bank, of Chicago, for $750,000. It is the purpose of the company, it is stated, to extend and improve the property and construct a long-distance line to New York.

BELTON, TEX.—The Belton Telephone Company has sold its exchange to the Southwestern Telegraph and Telephone Company. The Belton Company was organized about two years ago by the citizens on the co-operative plan. It is stated that it saved something over $10,000 in telephone business to the citizens and brought about necessary improvements in the old company's service.

Electric Light and Power.

SPENCERVILLE, OHIO.—Several business men have interested themselves in a project to establish an electric light plant here.

SPRING CITY, PA.—It is expected that the twin boroughs of Spring City and Royersford will soon have an electric light plant, to be owned and operated by local capitalists.

ANN ARBOR, MICH.—The City Council has decided to abandon the five electric light towers in this city, and the lamps will be distributed throughout the city where most needed.

HOLLY SPRINGS, MISS.—Mr. Walter G. Kirkpatrick, of Nashville, Tenn., and Canton, Miss., has been engaged to prepare plans and specifications for water works and an electric light plant for Holly Springs, Miss. When the plans and estimates are completed an election will be held.

ROME, GA.—The plant of the Rome Electric Light Company, which has been in the hands of a receiver for some time, was sold on April 6 by order of the court, and was bid in by Messrs. Dean, King and others, trustees for the bondholders—the American Security and Trust Company. The amount of the bid was $5,000.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has recently closed contracts for city isolated lighting plants for Greenup, Ky., and Lowell, Ind. It has also sold through its Minneapolis agents, Messrs. W. I. Gray & Co., a plant for the city of Morris, Minn. Besides these contracts the Commercial Company has on hand a large number of others for isolated lighting plants and motor work.

The Electric Railway.

LONDON, CANADA.—New York capitalists propose to build an electric road between London and Port Stanley.

BENNINGTON, VT.—The extension of the electric street railway is contemplated from Hoosick Falls to Bennington.

NEW HAVEN, CONN.—Papers have been signed for the new Milford and Lake Waramaug trolley road, a line 8 miles long.

ATTLEBORO, MASS.—A location will be sought in this town for another electric road. The route is between Attleboro and Norton.

LANCASTER, MASS.—Messrs. Paton and Dresser are interested in a proposed line from North Lancaster through Bolton to Hudson.

COLUMBIA, S. C.—The Brookland Railway Company will build a trolley line 4 miles long. Mr. John T. Sloan is manager of the company.

PAINESVILLE, OHIO.—The Lake County Commissioners will grant to Chas. H. Moody the franchise to build and operate an electric railway between Painesville and Fairport.

STROUDSBURG, PA.—The Delaware Valley Railway Company is negotiating for the charter of the East Stroudsburg & Matamoras Railroad. If the charter can be secured the railway will be rebuilt at once.

PATCHOGUE, L. I., N. Y.—The Patchogue & Port Jefferson Traction Company was granted a franchise to build and operate a trolley line between Port Jefferson and Patchogue. The road is required to be in operation Jan. 1, 1899.

WEST CHESTER, PA.—Mr. Eli Lewis, representing the Philadelphia, Castle Rock & West Chester Electric Railway, called upon the borough council relative to obtaining certain franchises in connection with the extension of the line in this place.

PITTSFIELD, MASS.—The railroad commissioners held a meeting to discuss the petition of the Chester & Beckett Railway Company for permission to issue $50,000 capital stock. J. H. Collier, of Hudson, N. Y., appeared as counsel for the company.

HOBOKEN, N. J.—The ordinance granting to the North Hudson County Railway Company the right to operate trolley cars in the streets of Hoboken has been signed by Mayor Fagan. The ordinance must be advertised for twenty days before the company can commence to construct the new road.

ST. LOUIS MO.—On the night of April 16 the Hamilton syndicate power house, which furnishes power to the Citizens', the Northern Central, Union, Baden, St. Louis & Southern and Marcus Avenue street car lines, was partially destroyed by fire. The loss on machinery, it is stated, will not exceed $10,000, but owing to the damage to the apparatus these roads were tied up. Thousands of people were compelled to walk to business, and it is stated that it will be some time before the roads will be able to resume their regular schedule.

BROOKLYN, N. Y.—The Brooklyn Heights Railroad Company has decided to sell its old horse railroad property at auction. This property consists of horse stables which have been rendered useless by the introduction of the trolley system throughout the city. There are ten stables in different sections of the city, valued at between $200,000 and $250,000, and the property will be sold on Wednesday, April 28. These stables include the old Bedford avenue depot, the Flatbush avenue stable, the stable at the corner of Ralph and Gates avenues, and the old Newtown stables at Newtown, L. I.

ST. LOUIS, MO.—On April 17 the Lindell Railway Company acquired control of the Missouri Railway Company's lines. The Missouri Company's system embraces three lines in this city, namely, the Olive street cable, the Market street, or Yellow line, and the Laclede Avenue Red line, the last two being operated by electric power. The stock of the Missouri Company sold recently for $150, but the new purchasers offer $165 for all that may be offered. It is stated that negotiations are pending for the consolidation of the Lindell, Scullen and Hamilton syndicate systems, controlling all the street railways of St. Louis.

INDIANAPOLIS, IND.—The 3-cent fare law which was passed at the recent session of the Legislature became operative on April 15. The patrons of the company offered the legal rate of fare, but the conductors refused to accept it and demanded 5 cents. In all cases where this was not paid the passengers were ejected from the cars. Considerable trouble was caused all through the day by the refusal of the passengers to pay more than 3 cents and of the conductors to accept less than 5 cents. In one instance traffic on the Pennsylvania street line was blocked for an hour because of the concerted action of thirty passengers, who refused to get off the car when ordered to do so, or to pay more than 3 cents each. The conductor was finally compelled to move the car, but refused to accept the fares. Popular indignation took definite form in open and organized resistance, citizens banding together for the protection of passengers and in defying the company's employees to eject them from the cars. A blind man was forcibly ejected from a car by the conductor, who was promptly arrested and taken to the station house charged with assault. On the night of April 16 the Grand Jury returned indictments against President Mason of the railway company and Superintendent Elliott for violating the law. Other indictments, it is stated, will be returned against them. These officials were subsequently arrested and gave bail. The company has brought suit in the Federal Court, asking for an injunction against the enforcement of the 3-cent fare law.

Legal Note.

THE ROOSEVELT TELEPHONE PATENT.—In the issue of The Electrical World of April 10 a brief note was published, announcing the decision of Judge Grosscup in the Roosevelt patent case in favor of the Western Telephone Construction Company and against the Western Electric Company. The suit was for alleged infringement of the Roosevelt patent, No. 215,837, which for many years back, it is stated, had been considered the fundamental automatic telephone switch patent. So broad and sweeping were its claims that it was supposed to cover every conceivable form of switches for changing from the calling to the talking circuits, and vice versa, by the mere act of taking the receiver from or replacing it on its point of support. The devices used by the Western Telephone Construction Company, which were claimed by the complainant to infringe the Roosevelt patent, were not only its old form of semi-manual switch where the hook had to be pulled down after hanging the receiver upon it, but also on its automatic form of hook switch, similar to which it is now turning out, where the only movement necessary to operate the same is to remove the receiver from or replace it on the hook. Judge Grosscup, in his decision, refers to the previous art, which disclosed means for getting the telephone and call bell alternately in circuit by means of a switch operated manually. The judge held that the Roosevelt patent covered purely an automatic switch, one which acted without the volition of the operator, and that it did not cover any switch which required any manual operation at all, or required the removal or replacing of the telephone from its point of support. This decision, it is stated, does not now affect the general public directly, the patent having expired by natural limitation.

Personal Note.

MR. T. W. HANSON, formerly connected with the J. H. McEwen Manufacturing Company, Ridgway, Pa., now occupies the position of superintendent of the Weston Engine Company, Painted Post, N. Y. Mr. Hanson is well known among the electrical fraternity as an energetic and thoroughly practical engineer.

Obituary Notes.

MR. WILLIAM ALLYN HUNGERFORD, New York manager of the Benedict & Burnham Manufacturing Company, Waterbury, Conn., died at his residence in New York City, on April 15. Mr. Hungerford was treasurer and a director of the company, and a member of various clubs in New York City. He was also a director of the Waterbury Watch Company, and of the Gas Engine & Power Company. Mr. Hungerford was 47 years of age at the time of his death. A widow, two sons and a daughter survive the deceased.

MR. CHARLES C. HINE, owner and editor of the "Insurance Monitor," of Newark, N. J., and an old-time telegrapher, died at his home in Newark on April 17, at the age of 72 years. Mr. Hine was born in New Haven, Conn., Dec. 1, 1825, and spent the earlier part of his life in Ohio, where he was a telegraph operator. He was at one time president of the Old Time Telegraphers' Association. Mr. Hine was well known as an authority on all matters pertaining to the insurance business. He settled in Newark in 1861, and was one of the most prominent and active citizens of that place.

MR. J. J. STORROW, the well-known patent lawyer of Boston, died suddenly on April 15 in the new Congressional Library Building, Washington, D. C. Mr. Storrow was in Washington on business before the Supreme Court, and was visiting the new Library Building, when he was suddenly taken ill and died in a few moments. Mr. Storrow was chief counsel for the Bell Company for several years. He was the representative of the Venezuelan Government before the commission appointed by President Cleveland to determinate the boundary line between Venezuela and British Guiana, and was one of the most eminent lawyers in Boston, in which city he was born in 1837.

Trade and Industrial Notes.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has just issued a price list of junction boxes which it is putt ng upon the market.

MR. THOMAS HILL, Jr., 81 Pine Street and 128 Water Street, New York, City, has taken the agency through the New England States for the Ahlm-Edwards Electric Company, Medina, Ohio.

I. P. FRINK, 551 Pearl Street, New York, has recently installed his special system of window reflectors in the store of Hackett, Carhart & Co., corner Broadway and 13th Street, New York City.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is reminding the trade that it still handles the reliable and time-tried swinging-ball lightning arrester, thousands of which have been sold throughout the United States during the last eight years.

THE AKRON ELECTRIC MANUFACTURING COMPANY, Akron, Ohio, has just opened a branch office in Buffalo, and placed it in charge of Mr. R. C. Demary, a well-known electrical constructor. Mr. Demary has just returned from Akron, and is well pleased with the business outlook.

THE WESTINGHOUSE GLASS COMPANY, Pittsburg, Pa., announces that it will run its factory steadily throughout the Summer without any stops, and that it is building an additional furnace which will be in operation by June 1 next. These increased facilities will double the company's present capacity.

SOME GOOD OPINIONS.—The Burt Manufacturing Company, Akron, Ohio, has just issued a booklet, giving testimonials of various concerns regarding the advantages of the Cross oil-filter, which is made by the Burt Company. Judging from these expressions of opinion, this filter seems to be giving very satisfactory results wherever it is used.

THE HASCALL STEAM GENERATOR, of which Messrs. Wendell & MacDuffie, 26 Cortlandt Street, New York, are the managers, seems to be meeting with much success wherever it has been installed, and is giving entire satisfaction. A large saving in fuel and a better supply of steam are the two main things that are accomplished by the use of this device.

THE J. W. RUGER MANUFACTURING COMPANY, Buffalo, N. Y., has just placed upon the market a new gas or gasoline engine, which is built by this company in sizes ranging from 5 to 35 horse-power. These new engines are particularly adapted for electric lighting purposes, and a copy of the company's illustrated catalogue setting forth their salient points may be obtained on request.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has the contract for furnishing for the government of Limon, Costa Rica, a market building constructed entirely of steel. This building is constructed in the form of a quadrangle 120 feet square. The interior court is 40 feet square, in the centre of which will be placed a fountain. Each side of this quadrangle will be 40 feet wide. The whole design of the market is neat and attractive in every way.

THE PHOENIX INTERIOR TELEPHONE COMPANY is doing an excellent business at its new quarters at 93 Washington Street, New York. The company now produces on the premises every part of its complete line of telephone appliances. The novel automatic generator cutout recently brought out is meeting with general approval. Mr. George W. Sutton is the designer of the various ingenious telephone devices being developed by the company.

MESSRS. EDWARD SMITH & CO., New York, have issued a paper-covered book on the subject of "Preservative Coatings for Iron Work." The book is very liberally illustrated with half-tone cuts of photographs representing a great variety of the applications of paints, varnishes and enamels for the protection of iron and steel structures, and hydraulic work. The present is the third edition, and is enlarged. It will be found of extreme interest to those concerned in such matters.

LINE SHAFTING.—The George V. Cresson Company, Philadelphia, has received a letter from tthe Edison Electric Illuminating Company, Pottsville, Pa., speaking in the highest terms of praise concerning the line shafting put in the latter company's station by the Cresson Company. The results, the letter states, were highly satisfactory to the Illuminating Company, and Mr. Haldeman, the manager, considers that his company should congratulate itself on the excellence of this work.

MICANITE IMPROVEMENTS.—The Mica Insulator Company, 218 Water Street, New York City, has recently added to its already extensive plant at Schenectady some new machines of special construction which mill its micanite plates to very exact thicknesses. Its special plates for different commutator segments are constantly growing in favor. They are guaranteed not to ooze cement at whatever temperature the commutator may reach in practice. The improvement in business, the company reports, is very encouraging.

BALL & WOOD ENGINES.—We are advised that the Northern Pacific Railway Company has recently placed an order with the Ball & Wood Company, New York, through the General Electric Company, for two of its Ball & Wood 100-hp simple engines, to be installed in the railway company's new office building in St. Paul, and also that the Ball & Wood Company is filling an order for two large tandem cross compound engines for the Portsmouth, Kittery & York Railway Company, a new electric railway which is expected to be ready for operation about June 1.

THE STANDARD PAINT COMPANY, 81 John Street, New York, has just arranged with the Electric Appliance Company, Chicago, to handle its P. & B. products. The latter company will carry a large stock on hand at all times, and its store will be known as the Western depot for P. & B. insulating compounds, armature varnish, tape, etc. It is prepared to fill all orders for these goods promptly and directly from stock. The fact that this arrangement enables electrical people to get P. & B. goods directly from a well-known electrical supply house is a good arrangement and will be appreciated by the electrical trade.

MAGNOLIA METAL.—The Magnolia Metal Company will on May 1 next remove its offices from 74 Cortlandt Street to Nos. 266 and 267 West Street, New York, where it will occupy the entire building. This change is made in order to secure increased facilities for storage, shipping, etc. The Magnolia Metal Company states that the fiscal year closed on March 1 shows a larger volume of business than any previous year during the past decade, the increase having been 25 per cent. over the business of the previous year. Its European business was found to be larger than its American business. The prospects for the present year, the company reports, are very good, and the feeling exists that the next year will be a better one for business.

CHASE CONSTRUCTION COMPANY, of Detroit, Mich., which has just been organized, is composed of pioneers in the electrical business. Mr. O. D. Chase, who is secretary and chief engineer of the company, was formerly superintendent of the Commercial Electric Engineering Company, and Mr. George E. Fisher, president and treasurer, was formerly business manager of the Commercial Company. The Chase Construction Company has secured the services of Mr. E. F. Mann as its superintendent of railway construction. Mr. Mann has had a large practical experience in railway work, covering a period of twelve years. The company has opened offices in the new Majestic Building, in Detroit, and anticipates a very active business during the coming summer.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 13, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

580,380. SUPPORTING MEANS FOR ELECTRIC RAILWAY SUPPLY CONDUCTORS; H. B. Davis, Pittsburg, Pa. App. filed June 10, 1896. A support for crossover and branching conductors for electric railways comprising a plate provided with a plurality of radial grooves, a cap-plate and means for clamping the conductors between the said plates.

580,381. SUPPORTING MEANS FOR ELECTRIC RAILWAY SUPPLY CONDUCTORS; H. P. Davis, Pittsburg, Pa. App. filed June 10, 1896. A supporting device for electric-railway conductors, consisting of a bar having a longitudinally grooved upper edge and a curved lower edge, and provided at one side, substantially midway of its ends, with a perforated ear, the perforation in said ear and the groove in said bar being in substantially the same horizontal plane.

580,384. ELECTRICAL INDICATING WATTMETER; T. Duncan, Fort Wayne, Indiana. App. filed Dec. 3, 1896. In a wattmeter the combination of a plurality of field-coils so arranged that their magnetic axes cross each other at right angles, and the magnetic axes of the diametric coils are out of alignment with each other and also with the axis of the inclosed volt-coil, and a vertically arranged volt-coil rigidly fixed upon a horizontal shaft within said field-coils and adapted to be actuated by the magnetic axes of said field-coils.

580,428. ELECTRODE FOR SECONDARY BATTERIES; F. W. Schneider, Triberg, Germany. App. filed Aug. 15, 1896. In combination in a battery cell, the supporting-frame, a series of electrodes supported thereby, and consisting of carriers having an imperforate lower part and a perforated upper part, the active material in the lower imperforate part, the inclosing casing and the liquid electrolyte filling the casing and passing through the perforations of the carriers.

580,434. TELEPHONE TRANSMITTER; A. Stromberg and A. Carlson, Chicago, Ill. App. filed Nov. 9, 1896. In a telephone transmitter, the combination with the diaphragm, of a sheet of gauze mounted upon the rear face thereof, a stationary electrode, a sheet of gauze mounted upon the face thereof, a sheet of coarse gauze, a ring separating the same from the sheet mounted upon the electrode, said sheet of coarse gauze having a rim encircling said electrode, a ring clamping said rim to the electrode, and provided with a flange, and a ring of plush or similar material between said flange and the diaphragm.

580,475. ELECTRIC RIVETING APPARATUS; E. Thomson, Lynn, Mass. App. filed June 14, 1889. In an electric riveting apparatus, the combination with a transformer whose secondary is a bar or rod, of a metallic anvil secured to and supported upon one terminal of said bar, and a metallic heading tool mounted opposite to the anvil upon the other terminal of said bar.

580,490. SYSTEM OF CONSTANT CURRENT GENERATION AND REGULATION; T. H. Hicks, Detroit, Mich. App. filed Nov. 5, 1894. In a system of constant-current generation and regulation, the combination of two electrical generators with a work-circuit, each of said generators having two sets of field magnet coils; one field-coil of each generator, and the work-circuit, being connected in linear series with each other, one field-coil of one generator being arranged in multiple arc with the work-

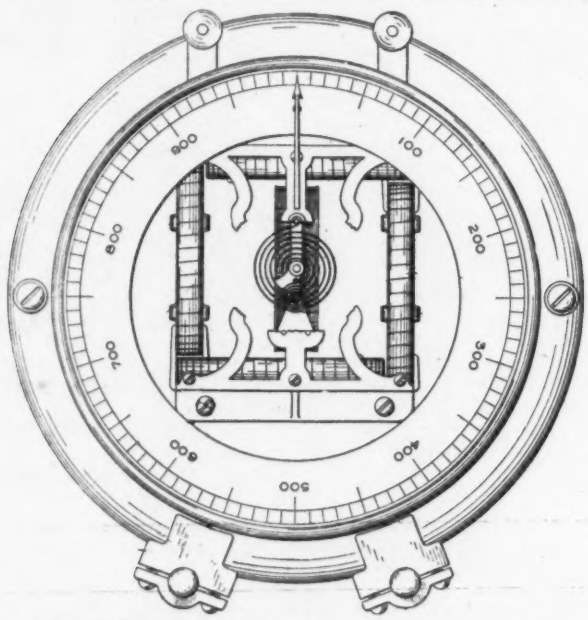
circuit, and the remaining field-coil being supplied with current from the other generator.

580,497. GALVANIC BATTERY ELEMENT; G. Laura, Turin, Italy. App. filed Feb. 27, 1895. A diaphragm for double liquid cells, consisting of a paste composed of a pulverized plant of the order of Malvaceae and a conductive substance as a solution of sodium chlorid.

580,519. CIRCUIT CONTROLLING APPARATUS; F. M. Brinckerhoff, Matteawan, N. Y. App. filed March 10, 1896. A circuit controlling apparatus consisting of a standard, a stud projecting from that standard; an arm loosely mounted upon that stud and a controlling arm, said arm carrying a knife and loosely mounted upon said stud, a spring connecting the arms, jaws fast to said standard, and means to actuate one of said arms.

580,523. GALVANIC BATTERY; R. W. Gordon, Boston, Mass. App. filed Oct. 1, 1894. In a battery cell containing an exciting fluid, the combination with a cover for the cell, of a negative element secured to and dependent from said cover and consisting of a cylindrical receptacle having perforated walls, a depolarizing agent contained in said receptacle, a positive element consisting of an annular plate or cylinder of zinc surrounding said negative element, insulated suspending rods or wires for said positive element secured at their upper ends to the cover and extending downward therefrom between the said elements and provided with supporting portions at their lower ends for said positive element, and an insulated conductor connectedat its lower end with said negative element and extending upward between said negative element and the positive element, and through the cover of the jar, said conductor being provided with a binding-post for one terminal of the circuit and one of said suspending rods being provided with a binding-post for the other terminal of the circuit.

580,552. BURGLAR ALARM SYSTEM; D. M. Munro, Gaithersburg, Md. App. filed May 25, 1896. In a burglar alarm system for the protection of buildings, the combination of a normally closed night-circuit through the entrances, a day-circuit around the entrances, a relay, and lines thereto,



No. 580,384.—ELECTRICAL INDICATING WATTMETER.

a normally open local circuit adapted to be closed by said relay, a switch in the night-circuit and an independent switch in the day-circuit.

580,557. ELECTRIC HEADLIGHT; R. P. Schwerin, San Francisco, Cal. App. filed Sept. 30, 1896. In an electric headlight, the combination of a parabolic casing having a top opening, a lamp-socket fixed in said opening, a parabolic mirror within the casing and separated therefrom to form a ventilating space or channel, an incandescent lamp fitted to said socket and passing through an opening in the mirror, a flat-glazed front for said casing, an air-inlet into the bottom of the casing just in front of the lower edge of the mirror, an air outlet between the upper portion of the mirror and the ventilating space, and an outlet from said space into the open air.

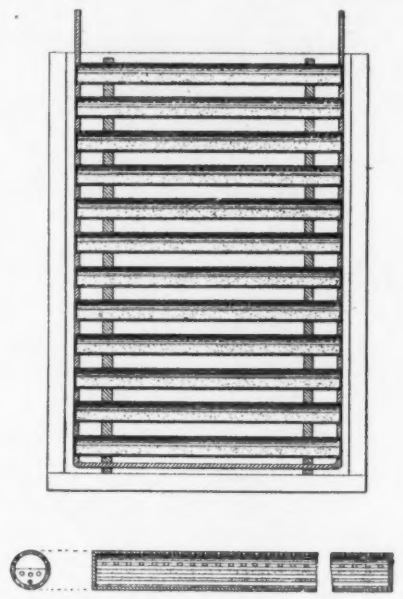
580,584. ART OF INSULATING ELECTRIC CONDUCTORS; A. J. Robertson, Chicago, Ill. App. filed Sept. 6, 1895. In electric transmission in the combination of a conductor, an insulating pipe, three pipes, a feed wire, a chamber, a support and an exhaust, said wires attached to and leading from an electric generator.

580,617. PRINTING TELEGRAPH; H. Kreusler, Kreischerville, N. Y. App. filed March 6, 1896. A telegraph transmitter, comprising a swinging arm, a keyboard, a screw-shaft for swinging the arm, a local circuit controlled by the keyboard for controlling the arm, the keys of the keyboard being so located as to arrest the motion of the arm.

580,628. INSULATOR AND INSULATING CONDUIT OR TUBING FOR ELECTRICAL PURPOSES; F. G. Treharne, Llanishen, England. App. filed Oct. 28, 1896. An electrical insulator, consisting of silicates impregnated with electrically non-conducting cement.

580,657. NON-INDUCTIVE ADJUSTABLE CARBON RESISTANCE; S. P. Blackmore, Johannesburg, South African Republic. App. filed Sept. 23, 1896. In combination, a casing having screw-threads externally of the ends, caps fitting over the ends, one of said caps with its screw-threaded connection being deeper than the other, loose carbon in the casing, hard carbon blocks contacting directly therewith and with the inner sides of the covers and the contact-screws passing through the caps, the deep cap with its screw-thread serving both as an adjustable compressor and a cover.

580,663. MEANS FOR CONTROLLING ELECTRIC CURRENTS; E. Ellicott, Chicago, Ill. App. filed Aug. 6, 1896. In a controlling-valve the combination with chambers or openings in the casing thereof communicating with the connections of said valve, of a central rotatable portion wherein are provided upon opposite diameters ports adapted to be rotated



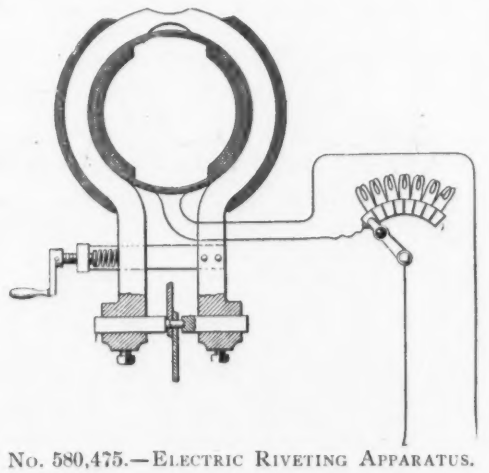
No. 580,428.—ELECTRODE FOR SECONDARY BATTERIES.

into position to connect the adjacent chambers or stops adapted to be rotated before a part of said openings or chambers, and close the same.

580,678. ELECTRIC SWITCH; T. H. Brady, New Britain, Conn. App. filed Jan. 9, 1897. In an electric double-pole switch, four contact-terminals, a central stem, and mechanism for imparting movements of partial rotation to said stem, in combination with an insulating disc, mounted loosely on said stem, and rotatable therewith, and carrying two circuit closing plates in contact with said contact-terminals.

580,680. ALARM LOCK; J. H. Doscher, Brooklyn, N. Y. App. filed March 26, 1896. In an alarm-lock an electric contact situated in and insulated from said lock and arranged in the path of a key entering the keyhole of said lock, the lock itself forming an opposite electric contact.

580,708. TROLLEY CATCHER; R. Orme, Racine, Wis. App. filed July 23, 1896. The combination on a car with a spring-actuated trolley-pole provided with a trolley-cord, of a pole-retrieving device mounted on the car comprising a gravity-actuated weight to which the cord is attached, a catch or catches releasably supporting the weight, and means by which the catches are actuated by the raising of the weight to automatically release it.



No. 580,475.—ELECTRIC RIVETING APPARATUS.

580,734. ELECTRIC ARC LAMP; A. C. Seibold, Mount Vernon, N. Y. App. filed May 11, 1892. An arc lamp having the electrodes around the arc inclosed in a small transparent or translucent normally air-tight casing, said casing being provided at one or both of its ends with closures engaging the electrodes, one or both of which constitute valves.

580,820. ELECTROMAGNETIC LOCKING DEVICE; E. J. M. Scheeren, Denver, Col. App. filed Oct. 13, 1896. The combination with the lock-casing, of an arm pivoted on the casing and inclosing thereby, said arm being adapted to move into the path of the bolt-withdrawing device, yokes respectively attached to the arm extremities and carrying pole-pieces projecting beyond the lock-casing, two distinct electromagnets located in suitable proximity to these pole-pieces respectively, circuits normally open, in which the magnets respectively lie, and suitable means, as push-buttons, for alternately and momentarily closing the circuits.